

COUNTY DEPARTMENT
PUBLIC LIBRARY
FORT WAYNE & ALLEN CO., IND.

THE PUBLIC LIBRARY

of

Fort Wayne and Allen County, Ind.
Information For Country Borrowers

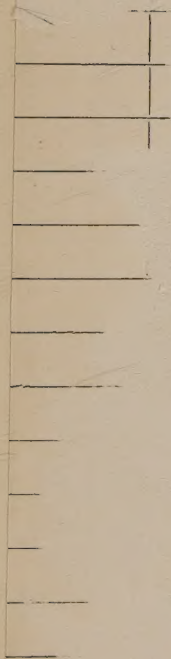
Books are free to all residents of Allen County. They may be borrowed from the Main Library at Fort Wayne or from any Branch, Reading Room, Deposit Station or School Library in Allen County.

Books will be sent by parcel post, prepaid to any borrower living a distance from a Library Station.

COUNTY DEPARTMENT
ANTHONY 3333

STO

**FRIENDS
OF ACPL**



THE CLEVER LITTLE PEOPLE
WITH SIX LEGS

STRANGE ADVENTURES IN NATURE'S WONDERLANDS

THE
CLEVER LITTLE PEOPLE
WITH SIX LEGS

BY

HALLAM HAWKSWORTH

AUTHOR OF "THE STRANGE ADVENTURES OF A PEBBLE" "THE ADVENTURES
OF A GRAIN OF DUST," "THE WORKSHOP OF THE MIND," ETC.

595
J

CHARLES SCRIBNER'S SONS

NEW YORK

CHICAGO

BOSTON

ATLANTA

SAN FRANCISCO

COPYRIGHT, 1924, BY
CHARLES SCRIBNER'S SONS

Printed in the United States of America.

A



FOREWORD

Whatever pleasure the seasoned agriculturist may find in "bugging potatoes"—to take an illustrative example of man's economic relation to his busy little fellow citizens in the World of the Six Legged—it is an occupation that makes little emotional appeal to the young.

Accordingly, while due emphasis has, it is believed, been laid on the practical aspects of a knowledge of the lives and habits of our common insects, the style of presentation, like that of the two preceeding books in the Nature's Wonderland series, assumes that if I fail to entertain my young readers they will get up and walk out!

A certain school man, commenting on my previous attempts in this direction, says that the important facts, given to the pupil in this non-technical, personal manner, have a great human appeal.

"That," he adds, "is the way to teach!"

And this—whether or not he has met with the full measure of success at which he aimed—the author confesses (out of hearing of the young people themselves, of course) is the fundamental purpose of the whole programme of entertainment in these "Strange Adventures in Nature's Wonderlands"—to teach.

Comments, favorable or otherwise, upon this educational undertaking, and suggestions for future books in the series, will be greatly appreciated.

H. H.

COLUMBUS, OHIO, Jan. 19, 1924.

OO. SCHOOLS

22059



CONTENTS

CHAPTER		PAGE
I.	<i>In the Wonderland of the Pigmy People . . .</i>	I
II.	<i>How the Lilliputians Keep Halloween . . .</i>	26
III.	<i>Sleepy-Time Stories for Winter Nights . . .</i>	48
IV.	<i>Sleepy-Time Stories for Winter Nights (Continued)</i>	72
V.	<i>New-Year Calls on a Few First Families . . .</i>	95
VI.	<i>Washington's Birthday and the Insect Republics</i>	118
VII.	<i>The Great Awakening</i>	139
VIII.	<i>Spring House Cleaning, Furnishing, Repairing and Building in Lilliputland</i>	163
IX.	<i>House Hunting and Moving in Lilliputland . . .</i>	189
X.	<i>The Truth About the Ant, the Grasshopper, and the Summer Boarders</i>	209
XI.	<i>The Canning Season in Lilliputland</i>	236
XII.	<i>The Great Summer Music Festival in Lilliput- land</i>	258
	<i>Index</i>	289

THE CLEVER LITTLE PEOPLE
WITH SIX LEGS



Copyrighted by Harper & Bros.

YOUNG ANT QUEENS ROMPING ON A PEBBLE

CHAPTER I

(SEPTEMBER)

IN THE WONDERLAND OF THE PIGMY PEOPLE

Oh, you needn't be surprised at any of the stories you read in *this* book!

Fairy-tales and Greek myths and the tales of the days of the knights have nothing in them so wonderful, so incredible; at least none that I ever read, and I've read about all of them, I think, at one time or another. Why, I believe if the story-book fairies and dragons and witches and such

could see some of the things we're going to see in the course of our adventures in The Land of the Six-Legged Peoples they'd say:

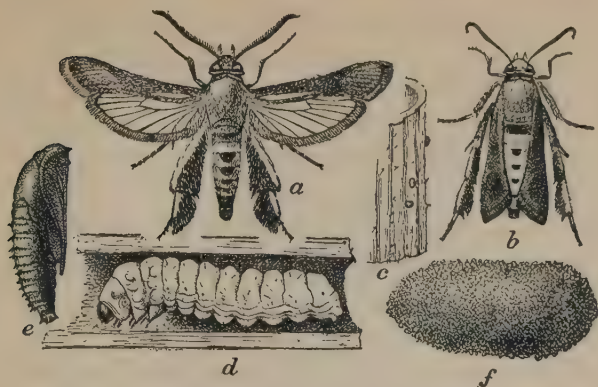
"*These* people are real! *We're* just made up!"

I have begun these stories of the six-legged peoples at the beginning of school in September because you have so recently met many of them personally, during the long vacation in the woods and fields — been bitten and stung by some of them, to whom you were not properly introduced, perhaps.

Moreover, I want to connect the whole idea of these out-of-door stories with your school life, because Nature Study, if you go about it in the right way, is one of the most delightful things and one of the most profitable, in either what we call the "common school" or the commoner school we call life. Nature Study not only teaches the great lesson the Ancient Mariner learned from the albatross — that of loving sympathy with all of God's creatures — but it teaches and trains us always to keep our minds and eyes open; to think and to reason; to inquire into and follow facts, wherever they may lead. And these are the very habits of mind that will be required for success and service in after life, no matter what our life-work may be.

I. THE CLEVERNESS OF THESE CLEVER PEOPLE

The most striking thing about an insect is not that it has six legs and that its body is divided into three parts — head, thorax, and abdomen; that its thorax and abdomen are divided into sections; and that it has those long feelers,



THE ARCH ENEMY OF THE PUMPKIN PIE

This is the pictorial family history of one of our uninvited guests who, as the saying goes, always have a finger in the pie — the pumpkin pie. At (a) is Mr. and at (b) is Mrs. *Melitta satyriniformis*; otherwise Mr. and Mrs. Squash Vine Borer — one of the most troublesome enemies of squashes and pumpkins. At (c) are shown the eggs on a bit of squash vine; at (d) the full-grown larva, which hatches from the egg in from six to fifteen days, according to the weather. In about four weeks the larva is grown up, leaves the stem, buries itself in the ground, forms its cocoon (f), and changes to the pupa state (e). Notice the little hornlike thing between the eyes of the pupa. With this, when the time comes to put on its wings, it cuts its way out of one end of the cocoon. Then, with those hooklike spines on its abdomen, it forces its way up to the surface and the sunlight and there becomes a winged moth like Mr. and Mrs. S. V. B. shown above. *Farmer's Bulletin* 660, which Uncle Sam will send you for the asking, tells more interesting things about these people.

or antennæ that, like the antennæ of the wireless telegraph system, tell it, by touch and by smell and by sound, so much of what is going on in its world. It *has* to have all these things in order to *be* an insect; to make the grade, as it were. No, the really wonderful thing about an insect is its cleverness, its knowledge of how to *do*; how to make a suit of clothes of wool, for instance, that always fits you (if you're that kind of an insect) and that is always new. Such a suit may cost a hundred dollars or more, but isn't it worth it? You'll find out all about these remarkable

suits — your mother knows a good deal about them already — in the very next chapter, which tells how the little people keep Halloween, with their disguise dresses and false faces and all.

False faces? Yes, indeed! In that chapter you'll meet an old friend — Alice in Wonderland — and I'll warrant you'll be as surprised as she was at some of these Halloween goings-on in Lilliputland, the land of the little people.

Chapter III (November) and Chapter IV (December) are given up to stories of the long winter night and the extraordinary things the Little People do in getting ready for bed. For instance, in the November chapter you'll see how the caterpillar of the Red Admiral Butterfly not only wraps itself in a blanket and sews itself up with silk, but dyes the blanket, for certain reasons, to match its nightclothes; how the birch-beetle mother tucks her babies in at the foot, and why; how some of the cradles of the insect babies are rocked by the winds, and how that helps keep the chickadees and other winter birds from disturbing the baby's sleep; and how these same winter winds help Mrs. Girdler Beetle put her babies to bed.

Yes, and don't think Mrs. Beetle doesn't know about this help of the winds. She *counts* on it!

In the December chapter you'll read about the slumber parties of the Ladybird Beetles — the kind of beetle you used to tell to fly away home because her home was on fire; and why the measuring-worms measure; how some of them play "twig" — not "tag" — with the birds; and about the great autumn house-parties of the wasps that, like the Duchess of Richmond's ball before the battle of Waterloo, always break up in a catastrophe; and about the

butterflies that give winter dances, and how you can get them to help you entertain at your winter parties.

THE CLEVEREST OF ALL THE CLEVER PEOPLE

Of course, the cleverest of all the clever people are the bees and the ants — everybody knows that — but when we come to "Washington's Birthday and the Insect Republics," in February, you may find several things about them that are new to you. For instance, did you know that there are bee burglars — I'm sorry! — and that the honest bees have a regular police system to protect themselves against the criminal classes? And did you know that the bees have a kind of newspaper without any paper — that is to say, they get and circulate news about the flower market in the spring and about new homes to rent when May-Day moving and other moving days come around, and how the "girl scouts" of Beedom help run this news system? And do you know why young bees are sent to work on white clover and how the clover blossoms keep books for them?

Or take the ants. Their wisdom and cleverness were famed even in Solomon's time, but new things are constantly being discovered. For instance, it is now known that they prefer south and east fronts, just as human house-keepers do; and they have what serves the purpose of an alarm-clock to help them take advantage of the daylight-saving plan in summer. And they not only put in a good long day's work every day, busy and happy as can be, but they sometimes work by moonlight, and many of them manage to go on working all winter.

In fact, all insects are notable for their industry. And,

with the higher classes, at least, such as the bees and the ants, and their kin, work is play; you can see it by the zeal with which they go at it. One kind of bee — the Leaf-cutter Bee that you so often see among the rose-bushes — actually puts in her time stuffing up earthworm burrows with leaves, even when she doesn't intend to lay eggs there — just because she likes to keep busy, apparently.

"Life with nothing interesting to do is *such* a bore!"

That's what she seems to say. Or as Fabre, the great French student of the insect, puts it: "This is her refuge from *ennui*."

AS HANDY AS A JACK-KNIFE

I don't want to hurt anybody's feelings, but I must say that the ants are even cleverer than their cousins the bees, in the use of their tools — and goodness knows the bees are clever! What I mean is that the ants haven't as many special tools to work with as the bees, and yet they can turn their hands to anything that comes along. Within the requirements of their jobs, they can do as many different things with their mandibles, those sharp little jaws of theirs, as you can with your jack-knife, if you're a boy; or with your scissors, if you're a girl. With these same mandibles the ant builds her many-chambered house; makes hallways and constructs pergolas, sheltered walks between the ant club-houses that you'll see when we come to that part of her story; uses them as scissors in slicing up leaves for helping to raise mushrooms; threshes out grain with them at harvest-time;¹ herds the little green cows with them; carries eggs with them, and carries the babies up

¹ This is done by the agricultural ants as described in "The Adventures of a Grain of Dust."

and down stairs and from room to room; cuts up game into steaks and hams when the ants go hunting; and uses them as combs when she cleans up and makes her toilet during the day's work, and when she goes to bed, and after she gets up from a nap, and in giving some worker a massage.

Among the various kinds of bees, some use this same kind of a notched mandible for reaping cotton, cutting leaves, moulding and spreading clay, putting up partitions in building, and in sawing wood so that from the sawdust they can make a kind of mortar.

MRS. WASP AND HER "TAMPING-IRON"

And just think what it means that a little mother wasp should go and get a pebble and use it as a front door; and then go and get another pebble and use it as a tool, a "tamping-iron" to pack down the dirt where she is working! You'll find this in one of the stories in this book — I forget just which — but, anyhow, you'll notice that, in selecting the pebble for her little stone door — it opens and shuts, too! — she doesn't take the first pebble she happens across. It must be just so — of the right size to fit into the doorway, and rather flat.

Imagine, too, what an eye she must have — the eye of an artist — to be able to carry in her mind such an accurate image of the size of the doorway that the stone must fit into! You know how it is when you try to draw a picture of anything, even of so simple a thing as a pebble; the moment you take your eyes off it the shape and relative size, as compared with surrounding objects in your picture, begin to fade out of your mind and you have to look again and again.

Yet there Mrs. Wasp goes buzzing around among pebbles of all shapes and sizes and never forgets! Where *did* she go to art school?

II. WHERE DID THESE WONDERFUL PIGMIES GET THEIR SCHOOLING?

For the matter of that, where did any of them get their schooling, these marvellous little architects and spinners and weavers and packers and paper-makers and actors and all? In other words, what is instinct?

I am writing this in the campus of Columbia University, and a little girl of twelve or so, who is a sixth-grade pupil there, in the famous Horace Mann school, is seated beside me with a number of her fellow students, working out a little idea of their own, the publication of a school periodical to be called *The Morningside Magazine*, and printed with her typewriter. I ask if I may contribute to the "Nature Column." The editor says I may — and she has hardly said it when, lo and behold, an ant, returning from her honeymoon, lights on my writing-board and shows us just how ants take off their wedding-journey wings before settling down to housekeeping. The little editor and the members of her staff tell me a lot about it, too — for the ant is one of the faculty at Columbia. As we get to talking about the ant people and the wonder of their ways, I ask the editor the same question:

"What is instinct?"

"It's being born knowing how to do things," she says.

And I believe that's about as good a definition as we'll find in our present knowledge of the subject; as good as

any of the professors at Columbia or anywhere else could give, I'll be bound!

"The word instinct," says one learned-science person, "is merely a convenient label for a package of little-understood facts that may some day tell us what instinct really is."

THE BANKER, THE BEES, AND THE BOTTLE

But the facts themselves are extremely interesting, and the attempts already made by men of science to read this one of the many riddles in Mother Nature's fascinating puzzle pages are no less interesting. For example, Sir John Lubbock, the London banker-scientist, who made a special study of bees, ants, and wasps, put some bees in a bottle without a cork to see how soon they would escape. He did the same thing with flies. The flies soon set themselves free, but the bees kept trying to fly through the glass until some of them died of hunger and exhaustion. From this Sir John was strongly inclined to infer that bees, brilliant as they are in their regular line of business, showed no real intelligence. They couldn't meet a new situation; and the flies seemed the more intelligent of the two.

But now just see what opposite conclusions may be reached from the same set of facts. "It was the very intelligence of the bees," says Maeterlinck, "that made them do this. The bees argue that they must go toward the light, just as they do in the hive. The feather-brained flies, on the other hand, flutter aimlessly here, there, everywhere, and finally strike an outlet."

Fabre, on the other hand, much as he loved all the little people of the insect world, did not believe that they have

any intelligence, in the human sense, and he gives these examples among others:

A certain species of digger-wasp always drags its food — long-horned grasshoppers — by the feelers. Fabre snipped off the feelers of a dead hopper that one of these wasps was dragging along. After vain efforts to secure the customary hold, the wasp gave it up as a bad job, although a leg hold would have answered just as well.

Once upon a day a mason bee was laying the first course of one of the clay cells in which these little mothers put up the lunch for their babies by storing it with honey and then laying the baby egg in the honey. Fabre took this cell away and replaced it with one already supplied with honey which he had borrowed for the purpose from another Mrs. Mason Bee. Mrs. Mason Bee No. 1, however, went right on building on this cell instead of laying her egg and closing it up.

But now hear some of the arguments on the other side. Mr. and Mrs. Peckham, whose observations of wasps are known among scientists all over the world, found that wasps differed greatly in natural ability. Among the pebble-using species, for example, one would hurry through her work, as if she didn't like housekeeping, anyhow, while another would spend a long time at the burrow, smoothing the surface with the greatest care and sweeping away every particle of dust made by her digging.

THE BEES AND THE NEW BRAND OF VARNISH

And when it comes to bees, there is no end to the evidence submitted to show that they have intelligence. For instance, two English scientists said: "Show us a single case

where bees, under stress of circumstances, have used clay instead of propolis, and we will admit that they can reason." Propolis is the stuff from the buds of trees, as you will see in Chapter VIII, that the bees use for varnish and other purposes connected with spring house cleaning and repairs. Well, sir, these learned men had hardly said "show us" when another naturalist replied:

"I coated the bark of trees near a hive of bees with a cement made of wax and turpentine that I knew would be better than propolis for their purpose, if they would only use it. And, sure enough, the bees stopped gathering propolis and used it."

"So there!"

"And, remember, gentlemen, this wasn't under stress of circumstances; the bees didn't *have* to use this new varnish that I put on the market. They saw it was a superior article at once, and so they adopted it."

"Why," says Maeterlinck, "any bee-keeper will tell you that when pollen is scarce he has only to put out a few handfuls of flour, and the bees soon learn this can be used for the same purpose as pollen, although the taste of it, the color of it, the smell of it, are absolutely different."

"Moreover," says another lawyer for the defense, "bees nowadays are continually supplied with ready-made foundations for their combs and always use them, even if Fabre's mason bee wouldn't meet him half-way when he tried to help her out."

"Yes, and by way of comparison with the intelligence of human beings," says another, "haven't you ever read in the travel books what the half-naked savages in the raw, miserable climate of Tierra del Fuego do when given a suit

of good warm clothes? They think of clothes, not as something to keep you warm, but as something to show off in! On pleasant days they strut around in their new suits, but on the raw, cold days they carefully hide them away and stand around shivering in the cold rain or the pelting sleet."

"Oh, don't talk about savages," says another. "What do you suppose the farmers did when they first saw the reaper at work? Laughed! And went right on mowing with their scythes! Or the business men when they saw the first typewriter? Said it did very pretty work, but their clerks wouldn't know how to run it; and, anyhow, the pen was better suited to *their* business! How long do you suppose it would take such people to use foundation combs if they had happened to have been born bees?"

And so it goes!

We know any quantity of things about how instinct acts, but precious little about what it really is, and still less about how it begins in the first place. But neither do we know what "intelligence" is, for that matter, although we know plenty of things about how it acts. It's a way the gray matter in our heads has of putting two and two together — we don't know how — and deciding — we don't know how — what should be done in a given instance; whether to use foundation combs in case you're a bee, perhaps — and certainly whether or not to use a reaper or a typewriter in case you're a farmer or a business man.

III. SCHOOL-DAYS AND CHILDHOOD WAYS IN LILLIPUTLAND

We also know how, among human beings, intelligence is cultivated and developed — namely, by going to school in

one way and another, and the same thing seems to be true, to a certain extent, among the upper classes of the insect world, the bees and the ants.

But, first of all, about the senses to be educated. Most insects have no brains; that would seem to be quite a handicap, right at the start. Such insects merely have ganglia, centres of gray matter scattered through their bodies and directly connected with their sense-organs. Their muscles obey their sensations as promptly and as inevitably as a steam-engine obeys the throttle or as a gun goes off when the hammer strikes the percussion cap. That's why the poor little moth will fly right into the flame of a candle. In common with other night-flying insects, it responds to the softened light of the night-time, and, seeing a dim light in the distance, flies toward it. In a similar way our eyes shut, without any thinking on our part, in a sudden flash of strong light, or the hand jerks itself away from something hot.

The sense of touch, through which human beings learn so much — particularly little human beings — is well represented in the insect world. As a rule, insects are a hairy people, and these little hairs or bristles are each connected with a nerve. These hairs are most numerous on the feelers, but are found all over the body.

INSECTS HAVE NO SENSE OF PAIN

Yet while, like a blind man's fingers, the hairs are so keenly alive to the touch of things that they tell the moth of the apple-worm, for example, the exact size of a bark crevice that will hide him best, insects, it seems, have no sense of pain; and that's a comforting thought to me in

the study of a world so full of little tragedies of one kind and another as this little world of the insects apparently is.

Professor Wheeler of Harvard tells of an ant which had lost its head in some affair — one of those battles of ants, perhaps, that Thoreau tells about in your Howe's Sixth Reader — yet it remained alive for forty-one days and walked about in apparently cheerful spirits until two days before its death from starvation; for, of course, being without a head, it couldn't get its meals. Another scientist tells of a wasp that had lost its whole abdomen, but went right on drinking syrup with evident gusto. Reverend John Wood, with whose natural-history books most boys are familiar, tells of a dragon-fly that lost its whole stomach and all that region of itself, but which, nevertheless, "devoured in quick succession thirty bluebottle flies."

Observation indicates that many insects have at least five senses; although we do not know to what extent they correspond with our own. One of these senses is that of balance — the sense that men try out in the army before they will let you into the flying service. The flies carry this sense in their undeveloped hind wings. These two little club-shaped things, although useless as wings, have an abundant supply of nerves, and without them the insect can't keep its balance in the air. Many insects are extremely responsive to variations of wind and temperature, as you will see in the case of the globe-trotting grasshoppers described in Chapter X.

DO INSECTS HEAR LIGHT?

It seems possible that some insects can hear light. Does that sound strange? Well, not so very long ago a profes-

sor in an English university invented a thing by which human beings could hear light; that is to say, light-waves were, in effect, changed into sound-waves. So, say some scientists, it is not unreasonable to suppose that insects may be keenly conscious of waves of light which our grosser human senses know nothing about. Lubbock found that ants could see ultra-violet rays invisible to human eyes and as different, possibly, from the colors we know as red is from yellow.

Insects have "sharp ears" for things they need to hear in the ordinary course of business, but there are other sounds they can't hear at all — they're too loud or something. But the "ears" of insects — the things they hear with — are situated in different parts of the body. The cricket, for example, seems to hear partly with its feelers and partly with a spot in its front legs.

Insects have a strong sense of smell, but, as hearing isn't a matter of ears with them, so smelling isn't a matter of noses. The smelling organs are numerous on the antennæ. These are not merely "feelers" but are also noses; as well, apparently, as things to hear with, in the case of some insects. And they are used for other purposes, some of which are not quite clear. Root, the apiarist, says a bee can smell a flower a mile away, and certain moths can catch from afar the perfume out of the sachet-bag of their lady moths as it streams out on the breeze of the country-side, although to the human nose there is no odor at all.

Like cats, many insects also have a remarkable sense of direction. Bees taken in a box two or three miles from home almost invariably find their way back.

This seems like being born knowing your geography, doesn't it? But yet, apparently, bees have to study geography in school, as it were — in the school of bee life. The young bees pass the first ten to fifteen days of their lives feeding their younger sisters — the babies still in the worm stage in their cradles, the cells. Then the first time they venture out of the hive these little sister nursemaids often have trouble in finding their way back, while those who have been doing outside work for some time, gathering nectar and pollen in the fields, have no trouble at all.

HOW BEES STUDY GEOGRAPHY

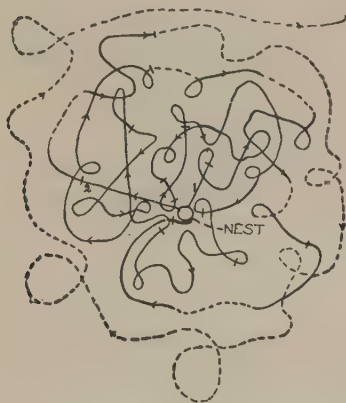
Yet even these experienced world travellers have to study up on their geography before they go abroad. Notice how they study it, as described in Maeterlinck's picturesque style:

In case of a new hive they hover aloft, with their heads turned persistently toward the new home. They take great soaring circles. Their 13,000 eyes question, reflect, and retain the trees and the fountain, the gate, and the walls until the way back home is as well marked as if laid in lines of steel.

Yet, as Maeterlinck says, it isn't the hive they seem to remember, but its precise location, "calculated to the minutest fraction" with reference to surrounding objects. He is wrong, however, when he adds: "If, after they have been kept all winter in the cellar, the hive, when set on its platform, should be put a little to the right or left, all the workers, on their return from the earliest flowers, will steer

to the precise spot it occupied the previous year. Only after groping around do they find the door."

The bees make this mistake only when the hive has been removed after they have made the locality study of it described in the preceding paragraph; otherwise it would be



HOW WASPS AND BEES STUDY GEOGRAPHY

Did you ever notice a burrowing wasp flitting about in the air like this — always turning with her face in one direction, until she flew away? She was studying the location of her burrow, so that she would be sure to know her way back. Bees study the location of the hive and its "front door" in the same way.

useless to ship bees from one part of the country to another, as is being constantly done; for then, instead of returning to the new hive, the bees would try to fly back to the "old homestead" away off somewhere else!

A baby bee spends the first week of her life in the hive. Then she goes out and takes a kind of breathing exercise that serves the same purpose as those you take in the schoolroom. This deep breathing fully expands her body. Then she stays close around the outside of the hive for

another week, playing in the front yard, as it were, and then, with her sisters born on the same day, she goes out to help gather the honey and pollen harvest in the orchards and the flowery fields. But at first she's like a timid little girl on her first day in school.

It is evident she is afraid. Daughter of the crowd and of the darkness of the hive, she shrinks at first from the vault of blue, from the infinite loneliness of the light. . . . She crosses the threshold and pauses, departs, returns twenty times.¹

And when she does start to find the nectar, she doesn't know at first just how to go about it, poking around in the most unlikely places.

THE HARDEST LESSON OF ALL FOR THE BEES

But if little bees are anything like little people — or grown people, either, for that matter — the very hardest lesson must be that of giving up one's own pleasure for the good of others. And that certain little bees must do on the great national holiday among the bees, which corresponds, I should say, to our Fourth of July; I mean swarming time, when the swarm makes its Declaration of Independence and goes off and sets up a nation of its own.

All the holiday makers are so excited about it they evidently can't think of anything else. They quit work entirely, eat their fill of honey — the only time in their lives when they do, for you can't work well with your stomach so full — fly around inside the hive in wild waltzes, go out and come back, and go out again to see if the queen is ready to start.

¹ Maeterlinck, "The Life of the Bee."

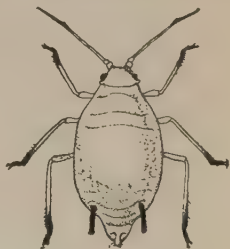
Then when all is ready away they go — everybody except a few of the old workers who remain to get food, and the young bees who must stay at home to attend their still younger sisters in the brood-cells.

When we remember that swarming day is absolutely the only holiday known in the life of the bee — no Sundays, no Saturday vacations, or anything like that — I say it's pretty hard!

But, of course, I'm only joking when I say that; for one of the most striking things about a bee is that it is perfectly content to be a bee. It puts in all its time at it and does all its duties with all its heart. So of insects in general. They concentrate along the few simple lines of their life-work; and you'll see the very same things in the lives of successful men in all lines. It is this concentration that works wonders in the mysterious gray substance in the head of man we call the brain.

And so it may be this magic stuff in the insect's make-up has responded to requirements in the history of the race, step by step, as man's civilization has grown step by step out of the crude and simple life of the cave-man. "No more marvellous atom exists," says one of the greatest modern scientists, "than the wee lump of nerve substance in the head of an ant."

"Insects," says another, "show more intelligence than any animal below man."



DON'T BE AFRAID OF MAKING MISTAKES

Somebody started the story that the honey-dew milk of the ant's little green cows comes from the two tubes on the "cow's" back. Professor Wheeler demonstrated it comes from the end of the abdomen.

Yes, but *whose* intelligence? While it is obvious they can learn a little from experience, such as the use of flour instead of pollen, I can't, by the wildest stretch of imagination, conceive of their "inventing" the wonderful ideas they employ in their work; that any great-great-grandmother of the wasp family, for example, should of her own self have conceived the idea of using a little stone for her front door and another little stone to tamp down the ground in her "front yard"; or that any bee should have figured out that a certain kind of cell would make her hard-earned wax go farthest — an endless number of things like that.

What I get out of it is that God so made this magic and mysterious substance which, in the head of man and other animals we call "brain," that it can respond to the demand of things to be done by showing us how to do them.

But as to how the brain works, even the human brain, we don't know a great deal. We know the conditions under which it works best, but that is about all. Of the process of its working — the machinery of it — we don't know much more than we know of the nature of instinct and its origin. This mysterious substance we call "brain," when it rubs up against circumstances and requirements in life, responds as did Aladdin's lamp to his rubbing, by bringing wondrous things to pass — remembering, imagining, deciding to do this or that — but we don't know how. There's as much mystery and magic about it as there is in that lamp story and the genii and all.

Didn't I tell you so at the start? ·

HIDE AND SEEK IN THE OPEN

(STRANGE AND CURIOUS THINGS TO BE SEEN IN THE LAND OF THE SIX-LEGGED IN SEPTEMBER. SEE INDEX ALSO UNDER "MONTH BY MONTH")

And I know of nothing better for doing this magic trick with your own brain than to watch and study the remarkable goings-on in The Land of the Little People. Do you know what Dan Beard says about that? "A boy, alert and fond of nature," says he, "will observe more things than the best-trained naturalist." And the great Fabre, "the Homer of the Insects," pays high tribute to the value of the sharp eyes of his little son Paul:

"He lends me his sight and hearing, and I, in exchange, present him with ideas which he receives attentively, raising his wide blue questioning eyes to mine."

Don't be afraid of making mistakes or of drawing wrong conclusions. Even famous scientists and trained students of science make mistakes. For instance, somebody who hadn't observed quite closely enough started the story that the honey-dew milk of the ant's little green cows comes from the two tubes on the "cow's" back; while, as a matter of fact, as Professor Wheeler's more recent observations demonstrated, it comes from the end of the abdomen. So great a man and so cautious an observer as Darwin made a similar mistake in repeating what he had been told about the honey-bees of California; namely, that after having been brought there from colder climates, they soon learned that flowers are to be had every month of the year, and so don't trouble to store honey. And so careful a literary artist as Maeterlinck repeats this statement of Darwin's in his "Life of the Bee." Now, as you know from your geography, California is one of our great honey-producing States, and the bees, neither in California nor elsewhere, change their habits, as stated.

One of the attractive things about this observation work is that the habits of some of the most remarkable of the insect peoples — the honey-bees and the ants, for example — can be so easily studied; the ants in a simple observation nest you can easily make, and the bees in an inexpensive observation hive. As it is so convenient to have some of your insect "teachers" in the house with you, so you will find it very helpful and interesting for reference, to carry this

book with you into the fields. And if you find the study of the lives of the Little People as fascinating as I hope you will, you will sooner or later want "The Field Book of Insects" by Doctor Lutz, head of the department of entomology of the great American Museum of Natural History in New York City. It is a miniature encyclopædia of the insect world and very convenient for the pocket. By writing to the museum you can get for ten cents Doctor Lutz's pamphlet on "How to Collect and Preserve Insects." A hand magnifying-glass costs very little and can be purchased of any dealer in optical goods.

Here are a few of the things to be observed in September:

The Monarch Butterflies are migrating southward, flying and drifting with the wind. When they rise, do they face toward or away from the wind? Observe and then see in this department for October whether you observed correctly. In spring Monarchs are said to migrate northward from regions farther south. There is at present no absolute evidence of this, but ragged specimens have been found in the region around New York City in the later part of April, and no adults of the Monarch have ever been found hibernating in the north, as the Mourning Cloaks and some other butterflies do.

Viceroy Butterflies, however, that look so much like the Monarchs you can hardly tell them apart (can you?) are preparing to go to bed and stay right where they are. You will find the Viceroy Caterpillar on willow and poplar twigs, making its winter case. Whether *you* know the difference between Monarch and Viceroy, the birds probably don't. Do you know how the Viceroys may profit by that fact? (Answer in October.)

The Painted Beauty, which you will still find on asters and other fall flowers, protects itself, not by pretending to be some other butterfly, but by playing dead, as you will see if you catch one. But release it and off it darts! The last broods of Violet Tip, Painted Lady, and Red Admiral are also to be seen; the Red Admiral sipping juices of decayed fruits. During the first half of September you will find the Painted Lady Caterpillar making its chrysalis. From this chrysalis the butterfly will appear the latter part of the month, fly about to the end of October, and then hide away for the winter.

The Red-Spotted Purple Butterfly is laying the last eggs of the season. These hatch in about a month, and the caterpillars find



THE GRAND ASSEMBLY OF THE MONARCHS

In the autumn, when the monarch butterflies get ready to migrate, you can see them gather, thick as leaves, and hang like this from the twigs of trees and bushes. In New York City you can see this royal assembly at any time of the year; for this is a picture of the migrating butterfly group in the American Museum of Natural History.

shelter for the winter. The caterpillars of the Cabbage Butterfly, the Black and Tiger Swallowtail Butterflies, and also of the large moths, such as *Cecropia*, change to chrysalids and so remain for all winter. The caterpillars of Sphinx Moths burrow and then change to the chrysalis state in little earthen cases, as will be explained in Chapter IV, which will also tell how to find these little Egyptians in their mummy-cases.

Watch for a pale-yellow butterfly laying its eggs on a red-clover leaf. Then watch for a certain fly that will come along and lay *its* eggs in the little green caterpillars that hatch from the eggs the butterfly laid. The flies will hatch into "worms" (*larvæ*) which will live on these caterpillars and then form their pale-yellow cocoons in clusters around the clover stems, and so pass the winter. If you gather these cocoons and keep them until spring, a little jack-in-the-box will raise his lid and peep out at you — the funniest thing in the world! (See March.)

Black crickets and tree-crickets are laying their last eggs of the season; the former in the ground, the latter in canes of raspberry and blackberry and the twigs of trees. The October chapter tells why ground-crickets dress in black and tree-crickets in green. Meanwhile see if you can't guess. Katydid's are laying their last eggs and singing the last songs of the season, keeping up their cheerful notes until the October frosts. But notice how "temperamental" katy is, lowering his voice with every passing shadow or ceasing altogether. Why is this? (Answer in October.)

The red ants are moving into their winter homes, for they belong to the landed aristocracy, if you please, "having summer and winter residences analogous to those of the wealthy," says Doctor Wheeler of Harvard, and move from one to the other in the spring and again during late August and early September; their summer nests are in open, sunny places, and they winter under stumps and rocks in protected spots in the woods. My friend, Francis T. Gilling, the artist, tells me that he used to find them in winter in the woods of the Catskills, frozen so hard that they would crumble between thumb and finger. Yet, even when so frozen they would, if warmed in the hand or by the fire, quickly thaw out and run around as lively as anything!

The little green cows of the ants now deposit their winter eggs around the buds and under the leaves of plants. Some of these

eggs the underground ants will take to their winter nests, so as to be sure of their supply of "fresh milk" in the spring. The ants hatch the eggs in their underground incubators and attend the young during the winter. In the spring they bring them out and put them back on the kind of plant on which the eggs were found in the fall. It is only the last plant-lice of the year that lay eggs. All the rest of the season they multiply by giving birth to living young. (See page 44.)

If you see grasshoppers with their abdomens sunk in holes in the ground — and you will if you look — these will be mother grasshoppers laying their last batch of eggs. They choose the beaten ground on the edge of pathways because it is packed and will not cave in, and thus is best suited for sinking the holes in which the mother lays her eggs. On the end of her abdomen she has four short triangular pieces that fit together into a point. This apparatus is called an ovipositor, or "egg layer." To make a hole for her eggs, she presses this point into the ground and then opens the ovipositor, thus pushing the earth aside and packing still more the walls of the hole she is making. Then she closes the ovipositor to a point again, pushes it down and opens it until the hole is as deep as the combined length of her abdomen and ovipositor. The eggs are laid around the edges of the hole, leaving an open space at the centre. (Try to think why, and then look in this department in June for the answer.)

Look for the Girdler Beetle making winter cradles for her babies, as described in Chapter III (November), p. 59. These little mothers begin making their curious cradles in August and keep on making more and more until November.

The Tumblebug Beetle baby's nursery, with its sun-parlor, is made while the mother is underground between July and September, as described in this department in July. After the autumn rains have softened the baked earth, the mother comes up to enjoy her last days.



Courtesy of Ginn and Company

YOUNG POLYPHEMUS IN PUGILISTIC ATTITUDE

CHAPTER II

(OCTOBER)

HOW THE LILLIPUTIANS KEEP HALLOWEEN

I don't suppose you take much stock any more in ghosts and witches, even on Halloween, do you?

You know, in the Halloweens of the old days, people used to see witches flying across the moon on their broomsticks, and hear squeaky spooks tiptoeing around in the dark, and meet weird faces moving about — at least they *said* they did. But anyhow, I want to tell you, whatever you think about that sort of thing, if you'll go with me into what I'd call the Halloween life of Lilliputland you'll see sights just as weird, just as strange and startling — particularly if you'll pretend you're a robin or a chickadee or Jenny Wren — any of those feathered folks that have to earn their living by mixing in the social life of the Little People, their Halloween games and all.

You must remember, though, that the Little People can't wait until October to have *their* Halloween — most of them have gone to bed by that time. They play their Halloween pranks on each other all summer, with false faces and masquerade dresses and everything! Just listen now and see if they don't.

I. STORY OF THE WORM THAT FRIGHTENED COCK ROBIN AWAY

You have heard the saying "a worm will turn," haven't you? Well, this is the worm. At all events, this worm *did* turn and, what's more, he made such a horrible face at Cock Robin that he almost scared him out of his feathers, and he flew!

Let's just pretend that you're Cock Robin and that you're telling the story to Alice in this Real Wonderland of the Six-Footed. I'll be Alice. Or, if you happen to be one of my girl readers *you* can be Alice and *I'll* be the Robin — I don't care! Alice, we'll imagine, sits on a grassy slope under a shady tree, reading a story-book, when up hops Cock Robin and exclaims:

"Alice! what *do* you think!"

"Goodness, gracious me!" cries Alice. "How you startle one! What do I think about what? One can't think anything about anything unless one has some idea of what one is to think about!"

"Of course not. I beg your pardon, Miss Alice, but I've just had *such* a shock!"

"Oh, tell me!" says Alice.

"Well, as you know, it keeps Mrs. Robin and myself hopping to feed those babies of ours. They eat two or three times their own weight every day. I understand the Bureau of Entomology at Washington estimates that one brood of robins eats half a million insects during the summer, including, of course, what they get for themselves after we stop feeding them. I don't know about the figures, as I never went that far in addition, but I *do* know that from morning to night those babies must have a worm, or a predigested bug, on an average of every two minutes. So we're on the go all the time for grubs, fishworms, caterpillars, slugs, beetles, and grasshoppers. When the children of one brood are old enough to put on their little speckled vests and go out with me, I take care of them while Mrs. Robin is busy hatching the next brood. I feed them, and teach them, and look after them generally, just as my good friends, Mr. Wren and Mr. Bluebird, do with their youngsters. We're all fine family men and good providers, if I do say it."

"Yes, I am sure you are, Mr. Cock Robin, but please get on with your story. What shocked you so?"

"Well, I started out rather late to-day — what with the cloudy morning and the rain — and I was hopping along through the edge of the garden when I came on a nice fat caterpillar on a bit of parsley. I was just reaching for him when what does he do but raise his head and begin swinging it from side to side in the ugliest way you ever saw! As much as to say: 'You just dare to touch *me* and I'll show *you*!' — at the same time making such a horrible face at me he nearly scared me out of my feathers, and I flew!

NO WONDER COCK ROBIN WAS INDIGNANT

"Really, he looked as if he meant to eat *me*, instead of letting me eat him — or take him home to the children — the way any well-bred caterpillar should! Can you imagine?"

"Indeed, I can," says little Chick Chickadee, coming along at the moment. "I had just such a shock myself only a little while ago."

"How was that, Chick?" asked Cock Robin.

"Well, yesterday I spied a worm feeding on the edge of a leaf. He's the worm that afterward gets to be a Polyphemus Butterfly, provided some of us don't get him first. I've eaten many of his kind, but it must have been that I always caught them when they weren't looking. For when I went to catch *this* one he raised his head, and of all the faces that ever I laid eyes on! Honestly, he reminded me of that big snake of India called the cobra, when it raises its head and spreads out its horrid hooded neck. He was fully three inches long! What a five-foot cobra, reared up in a jungle path, would be to a man, that three-inch worm was to me."

HOW POLYPHEMUS PUT ON HIS MASK

"And all because he put on his mask. He doesn't look at all like that when he's quietly eating a leaf. That's the queer part of it. He actually pulls a mask over his face, precisely as the boys and girls do on Halloween."

"Oh, Mr. Chick," exclaimed Alice.

"Fact!" said Chick. "And this is how he does it: he draws in his head, so that the front part of his body covers

his face and leaves a kind of cobra hood sticking out on each side. It was by the same kind of trick Cock Robin's caterpillar put on his false face, I'll be bound.

"And," Chick went on, "he made a snapping noise with his jaws, Polyphemus did! So that you could *hear* it!"

Alice looked at Cock Robin and coughed, and Cock Robin looked at Alice and gave a low chirp, but neither said anything.

"I see you don't believe it," said Chick. "And I don't blame you. I wouldn't have believed it myself."

Just then a sprightly little body flitted into the group.

"I hope I am not intruding," said she, "but you seem to be having such a nice, friendly chat I thought I would join you."

"If it isn't Jenny Wren!" cried Alice. "Please do! So glad to have you."

"Thank you," said Jenny. "I heard Mr. Chickadee speaking of the Polyphemus larva and how it makes a snapping noise to frighten enemies away."

(Jenny is quite a scholar; always says "larva" where other people say "worm" or "caterpillar" or "grub.")

"The Polyphemus larva does make a snapping sound which can be heard quite plainly. But speaking of bugaboo masks, I wonder if you know about the Spicebush Bugaboo?"

Alice admitted she *didn't* know but would like to.

"It's the larva that turns into the beautiful green Swallowtail Butterfly that you see from June to August hovering about the sassafras and the spicebushes. On the leaves the mother butterfly lays her eggs. These eggs hatch into the strange worm known as the Spicebush Bugaboo.

"I believe I have my share of self-control, but the first time I faced the Spicebush Bugaboo and he made that horrid face at me, I thought I must be dreaming and that



MONARCH ON A MILKWEED

this was one of those nightmares I've heard that human people have sometimes. Ugh! the uncanny stare of those two great dark eyes!"

ONLY STAGE MAKE-UP!

"But the strangest part of it is that it's merely a clever piece of stage make-up. Those eyes that frightened me so are not real eyes at all! They're simply two deep blue spots on his bright-green skin!"

"I've heard of him," said Cock Robin, "although I've never met him, as he's not on my beat."

"Yes, and as if all this weren't enough to frighten a body

out of a body's wits," continued Jenny, "he pushed out two horns at me!"

"Not only that, Miss Alice," said Chick, "but he uses poison gas! Some kind of stuff comes out of these horns and the smell of it is frightful!"

"Why," cried Alice, clapping her hands, "if that isn't just like the story of 'The Dragon and the Knight' that I was reading when Cock Robin came up awhile ago. The dragon not only *looked* horrid, but he had a breath that smelled like unsafety matches. The book says, 'his breath was as a sulphurous flame.'"

"Well, I'm glad *somebody* gets amusement out of it," laughed Cock Robin, "but we bird people don't see the joke, at the time, *I* can tell you."

II. OTHER MASQUERADERS AND THE PARTS THEY PLAY

And so let us suppose the pleasant chat of the afternoon goes on; Alice's feathered friends dropping in from time to time, and leaving their contributions to the news and gossip of this world of the Little People, and then flying away about their daily business.

But the talk was all from a bird point of view, you understand. Take the case of the Polyphemus Person and the Spicebush Bugaboo. It isn't nice for Little People to make faces at other people — we all know that — but when these Little People just *have* to do it to save their lives, why, that's a different thing again, don't you think?

These Little People not only have to put on various sorts of disguises and say "booh!" in various languages, to save themselves as best they can from the birds, but they have

other enemies. Take the case of the caterpillars of the puss-moths, for example. These queer little creatures are very common on the upper surface of aspen leaves and of



VICEROY BUTTERFLY THAT COUNTERFEITS THE MONARCH
FOR SELF-PROTECTION

willows and poplars. They wear a green vest, a white-bordered brown mantle, and a three-cornered hat, something like Napoleon Bonaparte's.

HOW PUSSY GETS HER BACK UP

Several of them will be browsing away as contented as a herd of cattle in a pasture, when all of a sudden they arch the fore part of their bodies, like a pussy-cat arching her back, and begin thrashing their tails about, as a cat does when it's angry. But the puss-moth caterpillars have a way of their own. They curl the back part of their bodies

up toward the head, run out a couple of little lashes from a pair of horn-like tails, and whip these lashes around their heads. They make you think of a cow trying to switch away a stinging fly.

And that's exactly what it's doing — this pussy-cat caterpillar. It's switching at a kind of fly that is trying its very best to lay an egg under the skin of the pussy caterpillar, just back of the head, so that the larva that hatches from the egg can have the pussy-cat to live on. To defend itself the puss-moth caterpillar not only does all I've said, but it spouts an acid out of its mouth and thrashes its head back and forth. This movement of the head makes it harder for the fly to land. This swaying movement also increases the range of the acid, just as the wigwagging of the garden hose scatters the water.

Furthermore, it puts on a false face, like the one the robin was telling Alice about. And by the same trick! It pulls its head back into the first body ring, much as a boy snuggles down in his overcoat collar on a cold day. And from the Spicebush Bugaboo apparently it has borrowed another idea. On this first body ring — and evidently for just such emergencies — are two intensely black spots. When the mask is on, these spots look for all the world like big eyes — terrible eyes!

The caterpillar of the Elephant Hawk Moth knows the mask dodge, too, but works it a little differently. This caterpillar is hard to see when at rest, on account of its green dress, which so closely matches the leaf on which it is feeding. But touch it and it suddenly draws the first three body rings into the rings behind. As a result, with all these rings around it, the body becomes enormously big,

and four spots on its skin suddenly turn into four enormous, weird eyes.

As in the case of the other maskers, the change is all the more jumpy because it's made so quickly. Moreover, one has no warning that it's going to be made at *all*!

A WITHERED LEAF TURNS INTO A SCORPION

The caterpillar of a European moth, known as the Lobster Moth because its caterpillar reminded somebody of a lobster, usually escapes notice by pretending to be a leaf, withered and crumpled. But let a bird or anybody meddle with it, and it turns into a scorpion, and with a row of horn-like things down the back, as if it had half a notion to be a Stegosaurus too!¹

III. HOW THE CLOTHES-MOTH ALTERS ITS TRAVELLING SUIT, AND OTHER FASHION NOTES

It's nothing to be surprised at, I suppose, that the peoples of the insect world have some ideas about dress that differ from those of human peoples. Like ourselves, to be sure, they put on fine clothes in order to be seen and admired, but they have other clothes that they put on *in order not to be seen at all*; queer things, some of them, like withered leaves, as you have just seen; some like pieces of bark covered with lichens; and old suits, dirty and gray as a clod of earth, such as the cutworm wears.

¹ "The Stegosaurus was one of those great monsters that used to roam around in swampy places ages ago. He was some twenty feet long and had huge, bony plates, like ploughshares, sticking out from the nape of his neck to the end of his tail. He seems to have gone about looking ugly and humpbacked, as our old cat does when she has words with the dog." — "The Adventures of a Grain of Dust."

A few of their disguise costumes are quite expensive — may cost forty dollars, fifty dollars, one hundred dollars, and more. Take the case of the little caterpillars of the clothes-moths, for example. They simply refuse to wear anything but wool. The clothes-moth caterpillar makes its travelling suit from the garment on which it hatches, and this suit is such a perfect match that usually, unless you look very closely, you can't see the little traveller at all.

This little travelling dressmaker knows something that our human tailors and dressmakers have yet to learn; namely, how to make a suit of clothes that will grow as fast as the wearer does and always be a perfect fit.

And in making a suit of this sort and keeping it up to date, as it were, the clothes-moth larva shows that it knows what a gusset is. Do *you* know what a gusset is? If you're a boy you probably don't, but if you're a girl you know a gusset is a piece let into a dress to make it larger. Well, when the clothes-moth youngster has grown so that its clothes are too tight, it can't let out any seams — the suit is all one piece, like a felt hat — so it takes its scissors and cuts along one side, from the end to the middle, and fills the gap by weaving in *new* material. Then it does the same thing on the other side and puts in a gusset, exactly opposite to the first gusset. How the little dressmaker can hit it so closely every time, without a measuring-tape or *anything*, beats me!

I forgot to say that the dress is fastened on with hooks and eyes. It is always lined with silk, which the worm spins, and in the loops of the silk threads are fastened some little hooks which, of course, belong to the worm's body.

What does it use for scissors? Oh, you guessed that, didn't you? The same kind of scissors the leaf-cutter bee uses to cut its pretty rose-leaf patterns and that insects generally use for all sorts of cutting and other purposes — its biting jaws. These jaw tools the Little People find almost as handy as a boy's jack-knife.

But, to come back to the subject of dresses and dress goods — green, brown, black, gray, and striped patterns are very popular for Halloween. (I am speaking now of the natural colorings and markings of the insects themselves.) The ground-cricket, hiding in dark places under stones and in rock crevices, and the mole-cricket in his underground castle, all dress in black. The tree-cricket, on the other hand, follow the fashion of their tree-dwelling cousins, the katydids, and dress in green. Species of grasshoppers that spend most of their time near the roots of grass stalks, dress in brown or brownish green to match their background, while the grasshoppers who live higher up in Grassland, where the sunlight strikes them, prefer green, or green relieved by yellow and red, to imitate the effect of the sun-rays shining through the green forests of grass and weeds in which they live.

IV. THE CODLING-MOTH AND THE NIGHT POLICE

Do you know there's a certain bad citizen that goes about at night robbing orchards, that none of the night force have been able to catch; no one except that little policeman with the leather wings, Mr. Bat. The other night men, such as the nightjars, don't do it, so far as any one has ever been able to find out, because, apparently,

they can't see the robbers. These robbers are known as codling-moths. One of them is not much bigger than a silver dime, even with its wings spread. Moreover, wearing dull-gray, as it always does, a codling-moth is about as easy to see, flitting around in the dusk, as a fleck of twilight! Then, in the daylight, when it's at rest with wings closed, even the sharp eyes of a bird can't make out where the dark-gray suit ends and the bark begins.

Yet the bats not only catch the codling-moths on the wing, but often dart down and get them in the very act of robbing the orchard; that is to say, of laying their eggs on the young apples. The worm that hatches from the egg the moth lays eats pears and quinces, as well as apples, but is better known as the "apple-worm," because it does most damage to apples. You can tell the apple-worm moth from the many gray millers of about the same size by a little horseshoe pattern of a bright copper color on the front wing. She lays her eggs in the young apple, and within a week or ten days there's a worm burrowing right into the heart of it.

ONE WHOLE APPLE TO A WORM!

The worst of it is that this moth keeps flitting from apple to apple, and generally lays only one egg on each — bad luck to her and her little horseshoe! Think of it, one whole apple to one little worm! But even that isn't all. This good-for-nothing little worm doesn't eat half of its apple; no, nor a quarter of it. It just eats its way to the core or thereabouts, gets its full growth in three weeks, and eats out through the other side. Then it lets itself down to the ground with a rope which it spins out as it goes,

much as a spider does, crawls to the trunk of the tree, and makes its cocoon under the bark. Then from these cocoons, along about the Fourth of July, say, out pop the



YOUNG SOLDIERS OF THE COMMON GOOD

moths again! Then the lady moths start laying *more* eggs, that make more worms, that make more mischief.

And so it goes!

But why do I tell you all this? For one thing, I think it interesting, like all the stories of the lives of these myriad peoples of the world of midgets. There's another reason, too, for these little biographies of harmful insects, and that is that by knowing their habits we can do something useful — very useful, indeed. Why, do you know that the apple-tree tent caterpillars have practically disappeared in certain school districts where the children have been getting after them? The children collected the eggs and the

tents in the spring and burned them, and each child was credited for his good service as part of his school work. The eggs are laid in little belts around the slender twigs and are not at all hard to find.

It is the fixed habit of these little Arabs of the tents to come out for their meals on the green leaves, almost as regularly as if they went by the clock. They are out for a late breakfast about 10 A. M., for the sun has dried the dew by that time. Then about the middle of the afternoon they're out again — a kind of afternoon tea. So the early morning and the evening are the times to find them in and do what must be done, if we are to have our fair share of the apples.

WON'T YOU LOOK OUT FOR THIS BIRD?

No bird, so far as anybody has found out, eats the tent-caterpillar moth. If you should happen to see some bird catching one, the fruit-growers all over the country would be much obliged if you would write to Uncle Sam, care of his Bureau of Entomology at Washington, and tell him what kind of a bird it was. Then Uncle Sam will put you and that bird on the honor list and send it all over the country.

If you have peach-trees, there are the peach-tree borers to be reckoned with. You'll know where they are at work by finding a mass of sawdust and gum on the trees right down near the ground. Cut into the bark with a knife, and at the bottom of these sawdust pits you'll find the borers. You can easily pull them out with a little piece of wire. This and the knife are the tools used for this purpose. If you leave the worms alone they'll come out

as moths the latter part of June, lay eggs on the peach-trees — and plum-trees, too — and within a week you've got a lot more worms on your hands. These moths, unlike so many other moths, are day fliers, and visit flowers for nectar and pollen.

Another orchard visitor that is not wanted is the round-headed apple-tree borer. You can trace him by his saw-dust, too, especially after a rain. The rain moistens the tree and makes it easier and pleasanter to eat, I suppose; like milk toast. This worm is the larva of a beetle.

Another beetle enemy, not only of apples but of pears, plums, and peaches, is the *flat-headed* apple-tree borer. You will find Mrs. Beetle herself busy early in June and through the summer, laying her eggs. She's a pretty little thing. You'd think she was all dressed up for a fancy-dress ball, with her shining coat of greenish black, with two rows of yellow spots, like brass buttons, down the back. But, unfortunately, she isn't going to any fancy-dress ball. She's as busy as she can be, running about right in the hot sun, laying tiny yellow eggs under the scales and in the cracks of the bark.

A BEETLE THAT TRADE-MARKS ITS FRUIT

You know how the fruit-growers have got into the way of putting a trade-mark on the boxes in which they ship, and on the wrappers, and even on the skins of such things as oranges? Well, it seems there's a beetle that has been trade-marking the fruit it handles, for goodness knows how long. She is a little, rough, brownish beetle with a long nose and little bumps, that look like brown sealing-wax, on each wing cover. She is a snout-beetle, known as the

Plum Curculio. She deals in plums, peaches, apricots, and cherries. When peaches, say, are about the size of a hazel-nut, she takes that long, sharp nose of hers, digs a



THE "LITTLE TURK"
AND HER TRADE-
MARK

slanting hole into the fruit, enlarges it at the bottom, and lays an egg in the mouth of the hole. Then with her nose she rams the eggs down. Finally, with this same remarkable nose-of-all-work, she cuts a crescent-shaped flap in the fruit, right under the hole into which she has rammed the egg. A nickname for this funny bug is "the little Turk." You understand why, don't you? (If not, turn to the dictionary and look at the picture of the Turkish flag.)

But what is she up to? Why does she do this? Her idea seems to be to make a scar so that the fruit can't grow at this point, and so crush the egg.

Now, before we go back to the house, after our stroll in the orchard on this beautiful October day, let's see what we can find in-

side of this windfall, a nice big pippin. Cut it open. Just look! A perfect maze of little tunnels all through it. That's the work of the railroad-worm! You remember how Chicago and other great railroad centres look on the map, don't you?

This railroad-worm, I want to say, is one of the worst customers you'll have to deal with. You'll see the fly that lays the egg buzzing about in June and July. She's called the "apple fly." She's a trifle smaller than the house-fly, but has a larger head for her size, and a queer body. This body of hers is shaped like a top, pin and all. With this pin she punctures the growing apple and lays in it just one egg. The result is that one of these flies, single-handed, can ruin from one to two bushels of nice apples.

It's against all this class of people that constant warfare must be waged. I've got nothing against them *personally*, you understand. They have their livings to earn, but so have *we*; and they would be just as well off if there were fewer of them!

HIDE AND SEEK IN THE OPEN

(STRANGE AND CURIOUS THINGS TO BE SEEN IN THE LAND OF THE SIX-LEGGED IN OCTOBER. SEE INDEX ALSO UNDER "MONTH BY MONTH")

In gathering material for your autumn bonfires don't forget that the cutworms are now going to bed for the winter. The weeds, brush, and other rubbish that is so often allowed to accumulate in the corners and along the fences of garden and orchard are their favorite places for "digging in." This rubbish should be raked away and burned and the soil here, as elsewhere, turned over in fall and spring, so bringing many of them to the surface to be disposed of. A particularly effective way of attacking them in the spring is to scatter in the garden, before planting and before setting seedlings, a mash of one part of Paris green to twenty-five parts of bran, diluted to half strength with water. But keep the chickens out!

In October break off and take home or to school cherry-tree twigs infested with the black-cherry aphids or plant-lice. With a hand lens you can see them laying their eggs between the bud and the twig. Twigs gathered in the winter will be found to have eggs behind the buds. Keep your twigs in a cool place until bud-burst-

ing time in the spring, and you will see the tiny eggs hatch into aphids.

But, in the spring, lo and behold, the aphids will reproduce, not by laying eggs, but by bearing living young, just as a pussy-cat does! They will begin doing this when they are about two weeks old. Then in two weeks more each of these first broods will be grandmothers of thousands of grandchildren; in a few weeks more the grandmothers and great-grandmothers of hundreds of thousands; and in a few weeks more, of millions!

Then, presto, another change in the curious lives of these aphid people! As the cherry-trees are about to die from the loss of sap which these busy bugs keep sucking out, what do these queer little creatures do but put on wings! That is to say, a winged generation appears and leaves the cherry-trees for some other plant. Apparently this new generation is born tired of the cherry juice of its parents and wants a change!

Watch for this migration about the time the cherries are ripe, and *if you can find to what plant the winged aphids go*, you will be making a very important discovery; for then these plants can be sprayed, as the aphid-infested trees are, with something that won't agree with them; and so there will be fewer aphids and more cherries for cherry-pies!

For plant-lice, scale-insects, squash-bugs — in fact, the bug tribes generally — soapy or oily sprays are used. Such sprays get into the pores through which they breathe and smother them. For insects that chew their meals, such as potato-bugs, currant, canker, cabbage, and codling-moth caterpillars — caterpillars in general — poisons are sprayed or dusted on the plant.

But, to continue the story of the migration of the aphids. Back they come in the fall from this unknown foreign land and lay their eggs behind the buds, as they are now doing in this month of October.

Those last sips of cider you see the Red Admiral Butterfly taking before turning in for the winter he owes largely to one of his cousins, the codling-moth, whose activities in the apple market we have already learned something about. Doctor Lutz tells me most of the codling-moth larvæ leave their burrow in the apple before it falls, and crawl down the limb, so that a band around the tree wouldn't catch many of these "south-bound" travellers, perhaps; but another effective way to fight them is to spray the leaves when

the eggs first hatch in the spring, since the caterpillars usually take a few mouthfuls of salad (*i. e.*, of the leaves) before they bore into the young apples. The apples that drop to the ground in the fall are apt to have these worms in them. Many could be collected and converted into apple-sauce or dumplings or apple-pies. The rest should be given to the pigs.

Sometimes in the spring the apple-worm leaves its winter quarters to spin a new and thinner cocoon; and sometimes it breaks open the winter cocoon and closes it again with a thin layer of silk, through which it can easily pass when it is ready for flight. But about the apple-worms' cocoons there's a special Halloween prank — a way they have of making them harder to find. Look at one with your hand lens, right where you find it on the tree, and see if you can't discover this trick. Then look in this department at the end of the December chapter and see if you *have* discovered it.

The last broods of the canker-worm moths are laying their eggs in the twigs of apple and elm, and the bud-worms are fastening their silken cases to the bark and twigs near the bud. The canker-worms belong to the measuring-worm family. The January chapter will tell you why they make that measuring motion in travelling; although if you happen to be reading this when measuring-worms are still to be seen, you may be able to *guess* why, by watching them and noting that they have no legs in the middle section of their bodies, as crawling caterpillars have.

If, among the autumn cocoons you find a puss-moth's house, you can probably answer this conundrum: "Why is a puss-moth's house so hard to find?" The answer is: "On account of the shingles." But why "on account of the shingles"? The answer to this answer you'll find in the December chapter — not in this department, but in the chapter itself.

Oh, and if you've never seen one, you mustn't miss your last opportunity of the year to see a gold-beetle! They are to be found, like drops of molten gold, on the leaves of the bindweed and other members of the morning-glory family, from July until October. Walking down a country road or across the summer or autumn fields you might pass thousands of them and never see one. Notice that many of the arrow-shaped leaves of this family of delicately beautiful flowers have little holes in them. Stoop down and look on the under side of such leaves, or turn them over quickly, and you'll probably find a drop of gold attached to it. That will be

little Mr. Gold-Beetle taking his morning sup of sap. But you'll have to be quick. In a flash he opens his golden wing-cases, starts his motors, and away he flies!

Yes, I see you've caught him. But what's this? In a few seconds he has turned to a milky iridescent opal, then to mother-of-pearl, and finally to a dull orange! Isn't he satisfied with being a beautiful golden bead? Does he think he's a whole jewelry shop? If you'll keep a few of these golden bugs in a box and supply them with morning-glory leaves you can see them change again and again.

Other members of the great and versatile family of beetles, some of whose habits you can study to advantage in October, are the ground-beetles, who are now going to bed for the winter under logs, and the long-horned beetles now burrowing deeper into the wood. Of the "June" bugs ("May" beetles, if you live farther south) the larvæ of some species "go to bed in their day clothes" for the winter sleep — that is, retain the grub form and burrow deeper into the soil; others change to the chrysalis form and then to adults, but remain in the chrysalis cells until spring.

The Ladybird Beetles you'll find gathered together in winter "slumber parties," under the leaves at the bases of trees, as described in the chapter for December.

But before we leave the subject of beetles I must tell you a most curious thing. When the wood is cut, some of them get worked into furniture, and this dry condition of the wood seems to lengthen their period of development; for they have been known to come out, fully developed beetles, from furniture that had been in the house for forty-five years. Think of being born forty-five years old!

Remember that when we come to the matter of birthdays and birthday parties in our chapter on "The Great Awakening" in March.

Doctor Lutz's "Field Book of Insects" will tell you something very curious about the black blister-beetles, that I haven't room for here — how they change their form five times! In the fall the adults die, leaving the larvæ in the soil to winter. In the spring the larvæ have eggs for breakfast — grasshopper eggs that they hunt for, burrowing around under the soil. They evidently have a "nose" for them, as the trained "truffle" pigs and "truffle" dogs of the Black Forest have for truffles. (Look up "truffles" in your encyclopædia.)

The Red Admiral and other butterflies that have "coming-out"

parties and butterfly balls in the winter (see December chapter), go to bed with their wings on toward the end of the month. House-flies also will go into hiding until spring in crevices in houses, barns, and sheds, and under the bark of trees.

Among the humbeebee peoples the drones and the workers die, while the queens seek shelter in holes in the ground or in hollow trees and in crevices in the trunks; and sometimes, perhaps, remain in the family nests over winter. (We don't know as much as we might about the habits of bumbles in winter — or at other times of the year, for that matter. You'd better make a note of that, too, young Mr. Thoreau or Miss Thoreau!)

Of the mud digger-wasps, the adults will all be dead by the end of October (unless frosts should be unusually late), leaving only the immature forms in cells to live through the winter. For the story of the late autumn parties of the social wasps — which you shouldn't miss if you can possibly attend — see December chapter.



Copyrighted by Harper & Bros.

HOW THE NOVEMBER WINDS HELP MRS. GIRDLER BEETLE
PUT HER BABIES TO BED

CHAPTER III

(NOVEMBER)

SLEEPY-TIME STORIES FOR WINTER NIGHTS

All through the fall months the folks in The Land of the Little People wander away to bed or are put to bed by their mothers. By the end of November everybody is tucked in for the long winter sleep. The crickets sit up pretty late, and you can still hear their cheerful chirp along sunny roadsides and in open meadows, clear up to the first hard frost. Some of the Little People — the crickets among them — go to bed in their day clothes, while others weave

themselves silk nightgowns, put on little rain-proof coats and, safe from the cold autumn rains and the sleet and the snow and the biting winter winds, they sleep as snug as you please, and dream that when they wake up they'll be a wonderful and quite different Somebody Else. And the dream comes true!

About this dream and about the Little People who sleep all through Christmas and New Year's time in their day clothes, I will tell you in the next chapter. In this chapter I want to speak of the sleeping habits of insects during the busy season, and about how certain mothers put their babies to bed.

I. THE SLEEP OF THE BUSY SEASON

I don't know whether that sluggard man ever went to the ant, as King Solomon told him to, but I'm sure if he did go to the ant, or to anybody else in the whole world of the Little People, for that matter — he ought to have been ashamed ever to say anything again about "a little more sleep, a little more slumber, a little more folding of the hands to rest."

Insects of all sorts may be observed occasionally remaining almost motionless for a considerable time, and they are supposed to be dozing, but being an insect is such a busy business, what with the housekeeping and the social events — such as the butterfly balls — and getting something to eat for the babies, and avoiding being eaten by somebody else, that you've got precious little time for sleep during the working season.

And some don't even stop to eat — they're so busy mak-

ing the most of their short lives! The May-flies, for example. Some species live for only a few hours in the winged state and others for only a few days. They don't eat a bite, but spend the whole of their fleeting minute-years dancing in the sunlight in wild enjoyment of those wonderful wings they had to wait so long for.¹

But all the events of adult life in this world of the Little People — even in the case of the Methuselahs among them — are crowded into so short a space that most of them seem to begrudge the time they give to sleep and get along with mere cat-naps; although there are leisurely citizens who believe in taking things easier — the tumblebugs, for example. They make it a regular practice to take a nap after each of their heavy meals. Then later you'll see them throw off the covers and pop up from their little burrows, rubbing the dust from their eyes with the flat of their feet.

Napoleon used to sleep only about four hours, on the average, when he was very busy, but then he made up for it afterward by sleeping a whole day at a time. Edison once said that people formed the habit of sleeping in the days before there was any good artificial light to work by, and that sleeping at all is a waste of time!

Of course, this was only one of his little jokes, but there *are* certain people who never sleep at all, and yet they keep as healthy as can be. I mean the honey-bee people. You've often heard the expression "as busy as a bee." As a matter of fact, no one ever *could* be as busy as a bee; not even Mr. Edison or Mr. Napoleon. I wonder if you know

¹ While the winged life of the May-flies is so short, the undeveloped state which precedes it lasts from one to three years.

just how busy a bee is? Listen now, and you'll see that its little life is busier than that of any human person ever was.

Honey-bees never sleep. The work of the hive during honey-making time, from early spring until the flowers are gone, goes on day and night. Combs must be built, the babies must be fed and given a drink of water every once in a while, the little fan wings must be kept going to ventilate the hive and help make the jelly "jell," and there is the night and day shift on the police force — to mention only some of the demands of good housekeeping and good citizenship in Beedom.

By watching your observation hive at home or in school you can see an individual bee here and there stopping and remaining motionless for a little while, but if she's asleep this sleep isn't anything more than a cat-nap, and she'll be up and at work again in a few moments.

THE CAT-NAPS OF THE ANTS

The ants are much the same way, although their naps seem to be longer. Look into a busy ant colony in an observation ant nest, and you'll see that some of them stop now and again and lie still, except for a rhythmical rise and fall of their fore feet and a gentle quivering of their feelers. Then every once in a while you'll see some other worker drop her pellet of earth instead of carrying it outside the nest, and come and push in among her dozing companions, as much as to say:

"Well, girls, if *you're* going to stop and take a nap I believe I will too!"

Sometimes ants will sleep an hour, sometimes two, de-

pending, for one thing, I suppose, on how tired they are. And then ants are like the rest of us. Some folks, you know, require a good deal more sleep than others. Those that get along with less sleep are usually of the more active, nervous type — of which the two famous men I referred to awhile ago are good examples. Such people seem to sleep fast, just as they think fast and work fast. Ants, apparently, are much the same way. The more active seem to require less time for sleep.

And ants are like human beings in another way. Before “going to bed” they seem to comb their hair, and then again after they wake they tidy themselves up a bit. And they also do this for each other, like girl roommates at a boarding-school.

TICKLING A SLEEPING ANT

What do you suppose would happen if you should tickle a sleeping ant? You can find out by doing what another boy did. I am speaking of Doctor McCook, to whom we owe the knowledge of so many new and interesting things about ants; for, like other eminent men, he found a boy’s delight in it all. He took a feather and stroked a sleeping ant, drawing it, gently at first, along the little creature’s back. She didn’t stir. He did it again. Still no sign of waking. And again, but the rhythmic rise and fall of the fore feet and the gentle quivering of the feelers continued.

My! What a sleepyhead! She must have had a particularly hard day’s work and been dog-tired. (Ants have their troubles, and their worries, too, apparently, as we shall see when we visit the ant republics in February, in connection with our celebration of Washington’s Birthday.)

But, anyhow, to go on with the present story, Doctor McCook made the stroke heavier, and finally tickled the ant's neck with the feather. Here are his very words:

I applied the feather to the neck with a waving motion, intended to tickle.

Still no response! Finally he pricked her with the end of the quill and she jumped up. I can imagine her saying:

"Bless my soul, what's all this about? Can't you folks let a body have a little rest *once* in a while?"

For perhaps she thought it was some of the other workers who were teasing her, and that was one reason why she was so hard to wake. The sleeping ants are used to being jostled about by workers rushing back and forth or climbing into bed with them.

Doctor McCook's ant stretched herself and seemed to yawn, much as a dog or a cat or a person does on waking, and began combing her antennæ and brushing her head and mouth—used the tooth-brush. (And yet we ourselves have to be taught that it isn't nice *not* to use the tooth-brush!)

Having finished her toilet, our little ant climbed over her sleeping companions, fairly dived into one of the hallways of the family residence, and started to work. She'd had such a good sleep she was just full of energy, you see. It also looked as if she thought she had slept too long, and said:

"Mercy me! See what time it is! I must get to work!"

And do you know that right now, in November, the ants are probably at work in the lower stories of their underground homes, below the ordinary frost-line. They go

right on, unless the temperature falls several degrees below zero.

CURIOUS SLEEPING HABITS OF THE WASPS

But the most curious sleeping habits in the insect world are those of the wasps. Take, for example, those wasps that make their burrows in the roots of trees. The lady wasps use the newly made burrows as sleeping-quarters, while the gentlemen sleep out — almost any place, under leaves or any other shelter that comes handy. The males of other species of digging wasps make little bedrooms of their own — holes in the ground — and go back to them night after night.

Two observers¹ tell of a male wasp — like most of the males in the lower animal world, a gentleman of leisure — who built a little bachelor apartment for himself in this way. And of all the lazybones! What do you think he did, this wasp-man-about-town? He went to bed one afternoon about four o'clock and didn't get up until ten the next day!

After retiring he always shut the door, according to the custom of the burrowing wasps, by filling it up with dirt.

About seven-thirty on the morning I have just spoken of he opened his door and peeped out, as if he wanted to see what the weather was like, or to "hook in the mornin' paper," as Mr. Dooley says. Then he went back to bed again. At eight-thirty his head was seen just inside the door, his long mustachios twitching this side and that, as much as to say in his lazy way:

¹ Mrs. George Peckham of Milwaukee. The studies of wasps by Mr. and Mrs. Peckham are among the classics of entomology.

“Well — I — don’t — know — about — it.”

Finally, out came his head, and he stood in the doorway for a few moments, looking around with quick, nervous jerks of his body, as if he were doing some kind of morning exercises. Then he turned and went back again.

“Oh, what’s the use? Nothing to do if I *do* get up!”

Not a sign of him until ten, when he came to the door again, looked around, and finally flew away. For all the world like a New York clubman, first standing in the door of his club and looking about and up at the sky, to see if he would better take an umbrella or a cane, and then starting down Fifth Avenue.

But before he leaves, Mr. Wasp-About-Town has to do something the clubman doesn’t; he has to fix his street number on his mind, as it were. When he flies out of his front door, he makes several circles in the air, each wider than the other, but always with his eye on the door. This is a habit with the digger-wasps. The lady digger-wasps, in the same way, make a mental map of the location of their front doors when they start for the meat-market. And no wonder, for they take a new room every day. For instance, suppose a Mrs. Wasp starts to housekeeping to-day. She digs out two holes and stocks one up with food for the baby wasps that are to be born in that room in the food she packs into it — caterpillars and flies and such; for the wasp mother lays her eggs on the food itself. The other of the two holes, the empty one, she’ll use to sleep in that night. Next day she’ll store the food and lay her eggs in Room No. 2, and make a new room to sleep in.

This changing rooms every night reminds me of the life of a commercial traveller, who practically lives in sleeping-

cars and hotels. And there are wasps that stop at "hotels," too. A lot of them will collect together in some convenient crack in a building or the trunk of a tree and sleep there until daybreak. The working-day in Waspdom, as among the bees and the ants, always begins at daybreak, unless it's cloudy or is raining. For, like these cousins of theirs, the wasps must have sunshine; and the hotter it is the more they pitch into their housework, humming cheerful little tunes to themselves all the time.

Before they get settled for the night these hotel wasps fuss around and jostle one another like chickens going to roost.

Wasps of still another species collect for the night in any tall grasses on the edge of the garden, clinging to the stems about one-third the way up. These wasps also do a lot of fluttering and jostling and talking, much as crows do when they get back to the community roost from the fields at night. You'll find both the wasps and the crows coming in about dusk every evening. Then, as soon as it's fairly light, the wasps are off to their work again. The crows get up early enough, so far as that goes, but it always seems to me they spend most of their time sitting around on fence-posts or the dead limbs of the trees, like idlers at a crossroads grocery-store, aimlessly discussing the caws of things and never getting anywhere in their arguments.

Sometimes, after a particularly hard day's work, or a couple of days of hard work — as in the case of one that kept at it for forty-two hours at a stretch — you'll see a wasp begin looking around among the plants and grasses near her little front door, several hours before the end of

the usual long working-day. Mr. and Mrs. Peckham saw a wasp doing that about four o'clock one afternoon. Pretty soon she disappeared. They found her hanging to a leaf in a natural shelter made by the surrounding leaves. At eight the next morning she was still fast asleep. They woke her gently. She climbed slowly up the stem, and, standing on the highest point, looked around as one might survey the world from an up-stairs porch in the morning. Then, after stretching herself, she proceeded to make her toilet, much as the ants do, giving herself a massage and washing her face like a cat, but using her hind legs as well as her front legs for the purpose.

Then away she flew to begin her day's work.

II. HOW CERTAIN LITTLE MOTHERS PUT THEIR BABIES TO BED

In getting ready for the long winter sleep the very littlest in the world of the Little People — that is to say, the babies — have to be put to bed by their mothers. We all know that, of course; but there are some things about it that are so strange, so like a fairy-tale that I, for one, never get over being astonished.

For instance, think of an insect mother actually tucking her baby in! She covers her baby with a leaf instead of a woolly blanket, to be sure, but she tucks this blanket in at the foot precisely as your mother used to tuck you in! There are other babies — brighter babies, perhaps — who help mother by tucking themselves in. The Red Admiral Butterfly baby, for example, not only wraps its own self in a blanket — in several blankets — but sews them to-

gether with silk, as neat as anything! Not only that, but it first dyes the blanket brown to match its nightclothes!

HOW THE WINTER WINDS HELP MRS. BEETLE PUT HER
BABIES TO BED

And I can tell you something else that sounds still more strange, perhaps; certainly more wild and picturesque. The cold winds of autumn, you know, make life pretty hard for most of the grown folks in The Land of the Little People. In fact, with some exceptions — including, curiously enough, certain butterflies which live all winter — the end of the summer is the end of the world for them. So it's pleasant to learn that these same rough winds do them a good turn now and then.

You know how long it takes to get some little human people to bed, what with one excuse and another; but it takes a much longer time for the little mother I'm going to tell you about now to get *her* baby to bed. It takes from August along into late November, and even then she has to have the help of the winds. This little mother is known as the "girdler beetle."

Notice, as you are walking through the woods after a heavy wind-storm toward the end of this month, if you don't find the ground covered with little twigs; particularly under the hickory-trees and the oaks. And all through the winter, after high winds, you'll find the same thing. If the ground is covered with snow so much the better; these twigs will be more easily seen. And you'll observe that they are not dead and dry, but young and sound.

Now, it isn't natural for a healthy little twig to act in that way. Being only a twig, it offers little resistance to

the wind; and, being young and supple, it bends, it doesn't break — unless somebody has been doing something to it. Somebody has! And that somebody is Mrs. Girdler Beetle! Look among the twigs and you're pretty sure to find a good many with a deep groove around them. This is her work.

If you had been on the watch in August you would probably have seen her girdling away on the oak and hickory trees in the woods, or the pear-trees in the orchard. She's a brown beetle, almost an inch long and with feelers as long as her body. She walks round and round a twig, cutting the groove with her mandibles as she goes. She doesn't sink the groove the whole depth at once, but little by little, much as the chisel does in a woodworking lathe, except that *her* chisels—her mandibles—cut by clipping.

She always stops just short of cutting the twig clear off. Having made her groove, she travels along the twig toward the tip — never the other way — until she comes to the leaf-bud at the end, and under the bark lays an egg. Then the twig, no longer being supplied with sap, gets dry and brittle at the groove and the high winds break it off. Changing the nursery rhyme just a little we can say:

“Rock-a-bye, baby, in the tree top,
When the twig bends the cradle will rock,
When the twig breaks the cradle will fall
And down comes rock-a-bye baby and all!”

But that's exactly what Mother Beetle counted on; for with the warm sun of May the egg hatches and the grub has a nice tender breakfast of sappy bark to begin on. And it continues to eat its cradle until it is ready to turn

into a perfect beetle and set up in the wood-turning business itself.

Did you ever hear of anything more interesting? But when I tell you that there are some 1,200 different kinds of wood-boring beetles in the United States alone — the girdlers are only one kind — you'll be glad that our little friends, the birds, are interested in them too!

THE SACRED BEETLE AND ITS BABY BED IN THE SUN-PARLOR

Here's another true fairy-story about the bedtime days and bedtime ways of the Little People that you might think was going to be too long to hear in an ordinary lifetime; for this story began some six thousand years ago, and the last chapter was written in only recent years by Fabre.

A relative of that clumsy little round-shouldered chap of the pastures and the roadsides that we've all watched many a time rolling his ball along, and that we call the "tumblebug," was a sacred being to the ancient Egyptians. For one thing, they thought that ball represented the sun — not the earth, as some books say, for the Egyptians thought the earth was flat — and that to be good to this beetle would be very pleasant to the sun-god, on whose favor the life of the wheat and the life of Egypt so plainly depend. So they treated these little bugs with great respect. They made images of them, as the Greeks did of their gods; that is to say, they engraved their forms in those beautiful little stones called "scarabs," of which you often see reproductions on rings and stick-pins. Original Egyptian scarabs you can see in the museums. On their scarabs the Egyptians frequently engraved short prayers to their gods, such as "Ammon protect thee" and "Mut



Copyrighted by Harper & Bros.

MRS. TUMBLEBUG HAS GONE SOUTH

give thee long life." And when the Egyptian laid down for his long sleep, these images of the sacred beetle were wrapped in the winding-sheet to say a good word for him before Osiris in the other world; for Osiris, the sun-god, was also judge of the dead. The sacred beetle, connected in this way with the idea of a new birth after death, became the symbol of immortality.

Moreover, these beetles themselves were supposed to be immortal. It was thought that all of them were males, and that, with them, to die meant simply to be born again. The Egyptians saw them bury themselves with their little rolling sun images under the ground, and then, long afterward, saw them come out again. So they supposed that these resurrected beetles were young ones born from the dead bodies of the old, as the new wheat grains were born from the ones that were sown in the fertile valley of the Nile.

The whole tradition of the beetles being sacred to the Egyptians, no Egyptian ever dared to think of digging them out, after they had buried themselves and their little globes, and so finding what the truth really was. And modern men of science, even after they *had* dug them out, made a mistake at first which it took the patient genius of Fabre to correct. These men of science thought the mother laid her eggs in these balls. But what Fabre found was this:

THE BABY BEETLE'S SUN-PARLOR

The ordinary balls the grown-up beetles take underground with them and eat. For the eggs, on the other hand, a special ball is prepared by the mother, on which

she builds a little sun-parlor. This sun-parlor joins the pantry, as you may say, for the ball is what the baby eats. The whole thing looks like a little pear, and, although underground, is so near the surface that the sun does the hatching. The mother lays her egg in the neck of the pear, near the surface.

This pear is made and the egg laid while the beetles are passing their long sojourn underground between June and September. When the autumn rains soften the baked earth, the mother and father beetles, pushing up with their stout backs and scrambling and digging with their stout legs, break through the soil and enjoy the remainder of their days until the frosty nights come. Then they die, and, in the following June and July, the next generation comes to life and the sunlight, and resumes the strange and ancient tale of the queer little beetle whose ancestors sleep with the dust of kings!

THE LITTLE ARABS AND THEIR TENTS

A very large number of the insect tribes might be called Arabs in the sense that they wander about and help themselves to other peoples' property. Like the Ishmaelites of the Bible, their hand is against every man, and every man's hand is against them, but the Arabs I'm going to tell you about now are still more like the wanderers of the desert in that they spend part of their lives in tents. Unfortunately for us, however, they don't "fold their tents like the Arab and silently steal away." They fold their tents *around* them and silently stay right where they are!

The mother I spoke of a few pages back, who tucks her babies in at the foot, belongs to one of these tent-dwelling

tribes. She's a beetle, too — the birch weevil — and she spends her life in birch-trees, where, in due course, she selects the leaf which is to serve her offspring both for a tent and a blanket. To make this tent she begins by cutting a long S-shaped slit through the leaf, extending from the edge to the midrib. Then she climbs up the leaf a little way and makes another cut, exactly like the first, but on the other side of the midrib. This is a very fine piece of engineering. Engineers themselves say so. It is exactly the kind of cut needed to keep the leaf from springing back when she starts to shape it into a tent. This she does by twisting the cut parts of the leaf into a funnel-shaped tent — like an Indian's wigwam.

Then, inside this "wigwam," which is to serve both as tent and blanket, as I said, she lays her egg, and *tucks in the tip of the leaf!* The point of this tucking-in business is, that by the time the grub hatches the leaf falls off, but the baby, being safely tucked in, stays in its cradle until it reaches full grubhood, feeding on the leaf itself. Then it digs under the ground, puts on its rain-coat — that is, changes to a chrysalis — and stays there all winter. Then, early in the following summer, out of the chrysalis comes the perfect weevil, which in turn climbs a birch-tree and starts this endless-chain story over again.

You'd hardly miss a tent like that of the birch weevil if you were looking for it, would you? But here's another little Arab that might easily deceive you. Its tent is set up in apple-trees. In the spring and summer, looking over an apple-tree in which these Arabs are camped, you will see here and there, among the green foliage, little masses of crumpled and withered leaves. You would know *some-*

thing had happened to these leaves, but you would never suspect there was anybody at home inside of them!

In the autumn, after all the rest of the leaves have been



The pretty seamstress which does the sewing.



The apple-leaf sewer and her work.



Case in which apple-leaf crumpler passes the winter.

WINTER BABIES IN THEIR BLANKETS

Here you see how two of the babies we have been talking about spend the winter under their blankets.

whirled away by the winds, you might well wonder why these same leaves which you had seen months ago, already old before their time, were still clinging to the tree, when they would naturally have been the first to go.

Look inside and you'll find the answer to the puzzle. There, hidden away for the winter, is a tiny horn-shaped

case, and inside the case is a half-grown apple caterpillar, known as the "leaf crumpler." The caterpillar fastens the leaves together in bunches with silk, and then *sews the leaves to the twig* with more silk. *That's* why the winds don't blow them off!

On these crumpled and clustered leaves the caterpillar feeds until full grown, about the middle of June. Then it changes to the chrysalis state, and in July becomes a moth and lays its eggs.

HOW THE TENT-MAKERS ANCHOR THEIR TENTS TO THE TREES

You know when you set up a tent you are careful to anchor it well with stout guy-ropes; otherwise the first strong wind that comes along, over it goes. Well, as you have just seen, these little tent-dwellers know about guy-ropes, too. Now we're going to see just how they use them in anchoring their tents against the winter winds. The tent-dweller that will show us the trick is one that we met at the Halloween party; I mean the *Promethea* caterpillar. When *Promethea* gets ready to go to bed for the winter, it chooses a leaf, and on it weaves a silk carpet. Then it walks up the leaf to the stem, and out on the stem to the twig from which the leaf hangs, still spinning out its silk. It spins over the leaf stem and around the twig until the stem is sewed on as stoutly for the purpose as mother sews a button on your coat.

Then it returns to the middle of the carpet and, by fastening threads on one side of the leaf and carrying them across to the other side, curls these opposite edges toward each other. It also gradually makes the threads shorter and shorter, as the space between the approaching edges

grows less and less. The result is a cover much like the cases in which some Indian mothers carry their papooses on their backs.

There is one more thing I ought to speak of — two more, in fact; one is that the caterpillar first works at the upper part of this winter home, and then turns its head down and works at the other end.

The second thing I have to add is that the anchoring serves a double purpose; it keeps the tent from blowing down, and it also makes it harder for the birds to eat the chrysalis that is formed inside of it. They can't get a good peck at it. It's like trying to fight a punching-bag! Don't you think it would be interesting for you and other Scout naturalists to watch and see whether the chickadee and his winter companions learn to manage it?

HIDE AND SEEK IN THE OPEN

(STRANGE AND CURIOUS THINGS TO BE SEEN IN THE LAND OF THE SIX-LEGGED IN NOVEMBER. SEE INDEX ALSO UNDER "MONTH BY MONTH")

Of all the six-legged people who disappear from the world in the autumn, the most remarkable in some respects is the cicada, the so-called "dog-day locust." Famous for his song even in the days of the Greeks, he would undoubtedly have excited their wonder and stirred their imaginations still more if they had known how much the true story of his life is like the Greek myth-story of Orpheus. You know about Orpheus and his harp and his wanderings in the underworld, don't you? Well, certain members of these insect musicians, the cicada family, who at this season of the year are under the ground, will stay there and wander about for seventeen years before they come back to the winged life and the sunlight! They are what is known as "seventeen-year locusts." Other species remain in the ground for shorter periods.

Like the grasshopper and some other insects, a mother cicada

has a very ingenious egg-laying apparatus — a combination of an awl and a double-edged saw. With the saw she cuts a V-shaped slit through the bark into the tender fibre of a twig or the tender tip of a branch, then bores a hole with the awl and fills the hole with eggs through a long tube, her “ovipositor” or egg-layer. She keeps this up until she has laid between 400 and 500 eggs.

When the young, hatched by the broiling summer sun, emerge, they are, as in the case of the grasshopper people, very much like their parents in looks, differing mainly in size. The first pair of their six legs are relatively large and are shaped somewhat like a lobster’s claws. Attached to their mouths and doubled back under the breast until wanted, like a closed jack-knife, is a long beak.

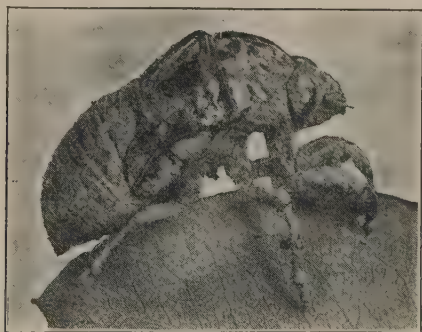
Looking in July or August under the trees where a cicada concert is going on, you’ll see the ground covered with little holes as big as a man’s thumb. These are the holes through which the cicadas have come up into the world of sunlight and song after many years of travel in the world of darkness under the ground.

As soon as they hatch from the eggs, the young cicadas drop to the ground under the tree, and with those lobster-claw spades begin digging. Soon they disappear and keep digging on down and down — you’d be surprised to see how fast — until they reach some tender branching rootlet of the tree in which they were born, or some other root. This rootlet is the young cicada’s boarding-house. Raising his little beak from under his breast, he thrusts it into the root and begins pumping into his system the sap on which he thrives and grows for two or three years — the difference in time depending, it is supposed, on weather conditions; unless he’s a seventeen-year locust, in which case, in our Northern States, he remains below for seventeen years, and in our Southern States for thirteen years.

When the time comes for the return of the little citizen of the dark, after these years of absence, he sets his face toward the upper air and the sunlight, and with those same busy spades of his, by the use of which he descended, he begins to dig his way up again. For weeks, for months, maybe (the question as to just how long, is one of the many nature puzzles left for some of us to solve), he digs and stops and digs again. The shaft is like other elevator-shafts, straight up and down, and he strengthens the walls with plaster as he ascends.

But the state of the weather has a good deal to do with his

movements at this period of his life; and you can't tell much about the weather when you're a couple of feet underground! So he digs until there is just a thin layer of earth between him and the surface. There, right under the roof, he hollows out a little attic chamber, and in this chamber, if the weather is too cool or threatens rain, he waits. But on the first fine day he cuts a hole through the roof with a few strokes of his spades, and out he comes, after all these



THE EMPTY SHELL OF A CICADA

years in foreign parts, back to the Old Homestead! It is doubtful if he remembers his birthplace. Yet one might think he had some dim recollection of it, the way he acts. He wanders about the vicinity for some little time.

Finally he stops doing this and climbs up some low bush or stout stalk of a weed, and proceeds to get outside of himself. He takes firm hold with the talon-like ends of his fore feet, and then, after a moment's pause, as if drawing breath for some great effort, he swells himself out, and his brown coat splits down the back. Then, through the split, he slowly climbs out of his old self and becomes quite a new creature — this time with wings.

Walking through the woods or along some country road bordered by shrubs, you may see one of the empty shells — a complete mould of the form of the cicada, still clasping a twig and swinging in the November wind.

Another equally curious thing you occasionally come across in walks in late autumn and winter woods is what looks like a big

black wasp pinned to the bark of a tree. With wings raised and body bent in an upward arch, she seems to be standing on tiptoe. This is the ichneumon-fly, and, if you are on the watch during the hot days of summer, and particularly in August, you can see, from the work of her sisters, how this one pinned herself to the bark, and so died there. She was working for the farmers and the fruit-growers, although she never asked them a cent. The kind of farm work done by Mrs. Ichneumon and her sisters I can best illustrate by "The Story of the Bewitched Cocoons" in William Hamilton Gibson's "Sharp Eyes."

One day, in a stroll through the November woods, Mr. Gibson gathered and gave a little girl friend some cocoons. He told her they were the cocoons of the Polyphemus moth. She laid them on the mantel at home, and one morning was delighted to see a new-born Polyphemus clinging to a vase. But the other cocoons hadn't opened. So she put them in a box, and one morning, when she raised the lid, to quote her letter to the artist:

"A great yellow wasp flew up into my face and almost frightened me to death! A few days later I opened the box again, and found it swarming with little wasps with red-and-black bodies and stingers half an inch long. Were they the big one's young ones or what?"

The answer to the little girl's puzzle is that all three were really and truly Polyphemus moth cocoons. "Then, how in the name of natural history," you may say, "could a *big wasp* hatch out of *one* of them and a lot of *little wasps* out of another, and from these two cocoons no Polyphemus at all!"

In the caterpillar that made one of the cocoons an ichneumon-fly had laid a number of eggs, which hatched, ate up the chrysalis of the Polyphemus in its cocoon, made their own chrysalides inside the big chrysalis of the Polyphemus, and then developed into what the little girl called "little wasps." A larger species of the ichneumon had laid eggs in another Polyphemus caterpillar and in the same way one of these eggs had developed into the big wasp.

A few species of ichneumons pass the winter in adult form — although not by pinning themselves to trees! — while others winter in an immature state. The ichneumon we found fastened to the tree by its own drill belongs to a species which makes a specialty of the larvæ of a certain wood-boring insect. With its delicate needle-like drill it drives through the hardest wood down to their bur-

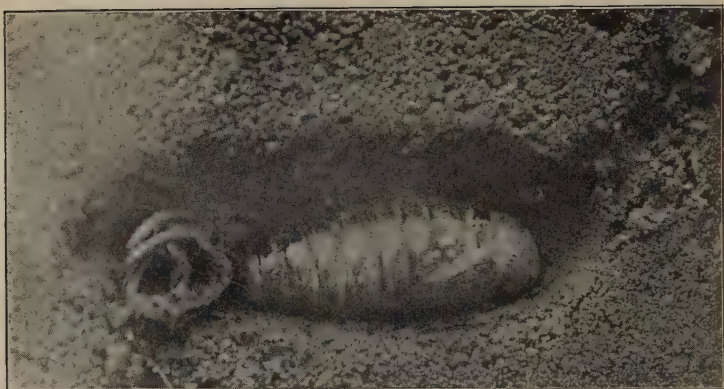
rows, four or five inches below the surface. After the ichneumon grubs hatch in these burrows they hunt up the wood-burrowing grubs and feed on them.

The drill has three parts, the drill proper and two sheaths to protect the drill from injury when not in use. These three parts are dovetailed and glide within one another. The drilling is done by alternate cutting of the two chisel-like tips, much as a quarryman with a hand drill drives holes into rock for blasting.

When the drill is at work the two sheaths loop up, higher and higher, as the drill sinks into the wood. These sheaths of the insect we found pinned to the tree look like horsehairs. Her last effort was too much for her, and she died from exhaustion apparently. The egg is laid through this drill, which the little girl thought was its stinger. The ichneumons are not true wasps, although they are related to the wasps. They have no stinger and won't hurt you. Their "stinger" is used solely as an ovipositor, while the queen bee's stinger can be used either to sting with or to lay eggs.



SECRET OF THE "BEWITCHED COCOONS"



Photograph by King

CHRYSALIS OF BURROWING CATERPILLAR IN UNDERGROUND CELL

CHAPTER IV

(DECEMBER)

SLEEPY-TIME STORIES FOR WINTER NIGHTS

(CONTINUED)

This chapter also has to do with the sleep of the long winter night. It tells first about the Little People who go to bed for this sleep without ever taking off their clothes, and then of the mystery sleep and the wonderful dream. The Little People we are to see going to bed in their day-clothes won't have this dream again, because they had it once and are themselves this dream come true.

I. LITTLE PEOPLE THAT GO TO BED IN THEIR DAY-CLOTHES

Among those who sleep in their day-clothes are the Little Folks that are so fond of late parties in the autumn — the

crickets. By the end of November the young crickets, that is, those that have one more moult to make before reaching complete crickethood, turn in for the winter; the baby mole crickets in their own private apartments and the others under friendly stones or logs or old gray-limbs of trees broken off by the winds and lying on the ground.

But while some half-grown crickets thus live to see the spring again, the parents are also careful to put away in the ground a lot of little white eggs that will, in due course, hatch into little black crickets. Early in November, while the days are still warm, the grown folks may be seen gathered thickly along the paths where the tramp of feet has made the soil nice and firm. There the female crickets, following the same methods as their cousins, the grasshoppers, sink little wells with their pointed egg-layers — their ovipositors — and in these wells lay their eggs. Then with the setting in of winter they die.

Under the logs the baby crickets have for company the ground-beetles. Some species of the ladybirds — they are beetles, too — tuck themselves away by hundreds, by thousands even, under the leaves “heaped in the hollows of the wood,” as Bryant says, and piled around the tree trunks by the whirling autumn winds. Other grown-ups of the beetle peoples — the black blister-beetles, for example — all die with the dying year. The larva babies they leave behind them burrow into the soil until spring, and so perpetuate the race. Of the beetles known in the northern part of the United States as June-bugs and in the South as May-bugs (because they come a month earlier), some change to the chrysalis and then to the adult state in the fall, but stay inside the chrysalis case and remain under-

ground until spring. The larvæ of other species, not yet having put on their waterproofs, burrow deeper into the soil. The larvæ of the wood-beetles, when fall comes, burrow deeper into the wood to a depth at which frost can't reach them, and go on eating until spring.

ORCHARD ENEMIES IN THE RUBBISH HEAP

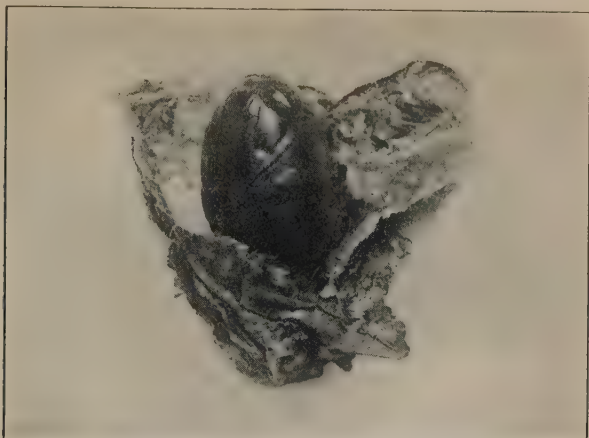
Another woodworker that needs looking after is the grape cane-borer. Some time during the spring and summer the



IN ITS WINTER HOME
UNDER THE BARK

beautiful young shoots of your grape-vines may suddenly begin dying, without apparent reason. Look at the joint where the shoot is attached to the parent vine, and there you will find a brown beetle about half an inch long. But it won't do much good to dispose of him if you stop with that. You must remember when fall and winter come to burn the rubbish in the orchard and cut off all the dead and dying limbs of the orchard trees and of other trees near by.

In dead limbs and under the rubbish of brush and dead weeds that accumulate in neglected corners the grown-up beetles of some species, and in others the larvæ and chrysalides, spend the winter. In the spring, bright and early, they start boring into the tender shoots of the grape. At the same time the mother beetles look after the next generation. As early as March



A CHRYSALIS THAT STIRRED IN ITS SLEEP

in the South and as late as June in the North, they lay their eggs in dead wood, and then the eggs hatch into "worms" (larvæ) and the "worms" become beetles.

So see that the rubbish of the orchard and the vineyard goes into your autumn bonfires.

In these same rubbish heaps are the eggs from which will come another and still more artful dodger. I refer to the cutworm. He, too, will be up bright and early in the spring to look after the first green shoots in the garden, and to see if the farm boy has his breakfast ready in the corn-field, according to the old rhyme about the number of grains of corn to be put into a hill:

"One for the blackbird,
One for the crow,
One for the cutworm,
And four to grow."

BUT OF ALL THE ARTFUL DODGERS!

I have just spoken of the cutworm as an "artful dodger," but of the whole artful-dodger tribe I'm inclined to give the palm to the canker-worm. He's a very Napoleon of strategy, worm though he is! He belongs to the measuring-worms — those curious little travellers that go humping their way along, because, having no legs in the middle section of their bodies, they are obliged to move in this way, a section at a time — first the front and then the rear.

Goodness knows how many kinds of canker-worms there are, but the "artful dodgers" I refer to belong to a species which buries itself in the ground in the fall. Having eaten the leaves of shade and orchard trees all summer, protected by the color of their coats, some of which are green like the leaves and others the color of the twigs, they lower themselves to the ground with their little silk ropes — you know that trick of various caterpillars — dig three or four inches into the ground, and change to the chrysalis state.

There, in their underground quarters, they stay until the first hard frosts, *when almost all the birds have gone south*. Then, during the first warm spell following, they come out as moths and lay their eggs! If there are no warm days in November they wait for a January or February thaw.

Then the caterpillars that hatch from these eggs are out as full-grown moths *before many birds come back*. These moths, in their turn, lay eggs from which come the next generation. You will find these eggs in neatly laid groups, often a hundred together, on the bark or twigs of the trees they infest. Fortunately the winter birds, especially the

chickadees, know about this and so have eggs for breakfast, luncheon, and dinner all through the winter.

As if all the canker-worm tricks I've mentioned were not enough to puzzle us, some of these canker-worms — the ones that are the color of twigs — know how to hang to the bark with their hind legs, and then, sticking their bodies out into the air and holding them straight, pretend to be twigs themselves! This is a summer trick, of course.

But, in spite of all this, it has been found that by entertaining our feathered friends of the orchard during the winter with an occasional luncheon they will stay around and keep the orchard clear of canker-worms. You can also be of great help in getting rid of them by putting bands of coal-tar mixed with oil or printers' ink around the trees in the spring, before the females climb up and lay their eggs; for the females, having no wings, are obliged to climb.

THE GAY WASP PARTY AND THE WATERLOO!

Under loose bark and inside of the logs under which the crickets have engaged rooms for the winter — provided the log is hollow — or in any place in the log hollowed by decay, young queens of the brown wasps, hornets, yellow-jackets, or bumblebees may also have settled for the long night. These young queens are the last survivors of their race, the old queen, the drones, and the workers always dying off at the end of the year.

In a prosperous colony of social wasps there are, at the height of the season, thousands of citizens, all children of the queen mother who started the colony in the spring. But these wasps, with the exception of the queen and the males, all belong to the worker class, and, like the workers

among the ants and the bees, are incapable of having children. So, as autumn approaches, among most species of social wasps, special cells are added to the lower comb of the nest, which, like the queen cells of the bees, are larger than the cells in the combs above. In these the queen lays eggs, and none of these eggs hatch into workers — all are either males or females, princes or princesses of the royal line of Waspdom.

As soon as these princes and princesses come of age, the life of the nest becomes one continual round of social gaiety and everybody is as wildly excited as the bees are in a hive when the queen takes her marriage flight at swarming time. A curious thing — as the bees would look at it, I suppose — is that there is none of that deadly rivalry among the wasp princesses that marks the life of the beehive. They get along without a word, apparently, and there is continual love-making and mating between the princes and the princesses. All is “merry as a marriage bell,” to quote Byron’s lines.

But like the merrymaking at the ball before the battle of Waterloo, this gaiety of the wasps is followed by tragedy; and we might add another quotation from Byron’s poem with a slight variation:

“Did ye not hear it? Yes, ’twas the wind!
This *ends* the dance!”

For with the coming of the cold winds of autumn, all is over! The princes die by hundreds and the workers by thousands. With them dies the old queen; and only the princesses, the mother queens of next year’s wasp colonies, survive. Sometimes, though rarely, these princesses stay

in the home nest, it is said.¹ Most of them go away and hide in convenient holes and crevices elsewhere and "pass the winter in lonely widowhood," as Bastin, the English naturalist, expresses it.

In your own home you may, at this very moment, be entertaining royalty unaware; for these young mother queens often get into attics in the late fall, through an open window or a broken pane, and there, hidden in some crevice, await the call of life in the spring.

WINTER BALLS AMONG THE BUTTERFLIES

But while the gay life of summer thus ends with one grand dance — and then Waterloo! — in Waspdom, there are certain other well-known society folks of Lilliputland who give dances right in midwinter, the very season when the newspaper society columns are filled with dances and dances to be!

Now, tell me, who of all people on earth you would least expect to meet in the winter-time? Wouldn't it be Lady Butterfly or Lord Butterfly? And in their ball dresses, of course, for they always wear them. Well, you come with me during the first warm spell in winter — when there is what is called a "thaw" — and we'll meet both of them. It may be Lord and Lady Antiopa, or Lord and Lady Comma, or Miss Semicolon, or Miss Atlanta, or Madame Red Admiral — or all of them.

As late as the middle of October, when most caterpillars have gone to bed and pulled their silk comforters over

¹ Doctor Lutz, head of the department of entomology of the American Museum, tells me he has often looked for them in the nest but always in vain.

them, you are likely to find the last broods of caterpillars of the butterflies I have just named, still feeding. Then, after they have gone to bed in their cocoons, they seem to be restless sleepers; for in a couple of weeks out they come with their new wings on! Frosts? The frosts only seem



Copyrighted by Harper & Bros.

ANGEL WING BUTTERFLY FLUTTERING ON A WINTER TWIG

to make them more eager to be about. No blossoms? No nectar? What of that? There is plenty of good cider to be had! Watch one of the beautiful little creatures poised on a windfall or a brown frozen apple, after a thaw. It's sipping the natural cider inside the apple.

When the weather becomes very bitter, in the latter part of November, perhaps — or it may be earlier — butterflies of the species I named hide in crevices, in cracks in and

under the bark of tree trunks, and under loose clapboards and under the shingles — by hundreds sometimes. Then let there come a thaw in the winter, any time from January to February, and you'll see them out again; and even when there has been no general thaw you may find them in any sunny, sheltered nook.

You can keep them alive in the house for a little while. They will flutter about you and light on you as if they wanted to be petted — the dainty little creatures! Wouldn't it be a lovely thing to have these winter flowers as decorations for the Christmas dinner-table? All you need to do is to set a shallow dish on the table with some cider in it and the butterflies will do the rest.

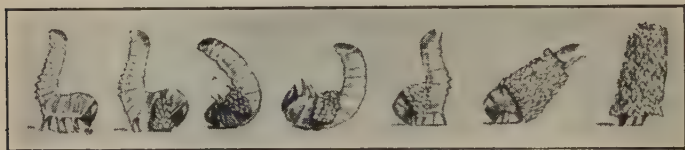
II. THE MYSTERY SLEEP AND THE WONDERFUL DREAM

Do you suppose the Little People of The Land of the Six-Legged, when they go away into The Land of Sleep, ever dream? If they do, they must dream strange dreams. For what could be stranger than to dream you are turning into Somebody Else and then to have the dream come true!

This marvellous change comes during the sleep of all the Little People that you find wrapped up in their cocoons on the trunks and under the bark of trees, or hanging from the twigs or buried in the ground. Among the cradles of the sleeping babies hung from the twigs and rocked by the winter winds are the big cocoons of the Cecropia moth. The Cecropia, Promethea, Polyphemus, Io, and Luna moths all belong to the same family, and their way of wrapping

the drapery of their couch about them and lying down to pleasant dreams (as Bryant says in "Thanatopsis") is practically the same. If you are on the watch in September you will see *Cecropia* make its silken bedcover, fasten itself to a twig, and go to bed for the winter.

It takes firm hold of the twig with its hind feet, and



Copyrighted by Harper & Bros.

HOW THE BAGWORM GETS INTO HIS CABIN

then, raising its head, begins spinning out the long silk threads. These threads it first fastens at the top, then carries down one side, then across the bottom, then back to the top again. Then it bites off the thread — as a seamstress often does, by the way — and spins out another thread, which likewise goes the rounds down the side, across the bottom, up to the top. As long as you can see it — that is, until the caterpillar is entirely hidden by the silk quilt it makes — its head keeps moving back and forth, back and forth, like a shuttle in a loom. If you tried to count all these motions you'd find it a pretty big sum in addition, for they run up to a quarter of a million! Of course, you'd get tired counting, long before the caterpillar got through, but you could count the number of motions for one minute, and then multiply by the number of minutes required to complete the job. That's the way the scientific people do such things.

After the caterpillar has completed a thin webbing of silk, attached all around the edges, it pushes the webbing out in the middle. This gives the cocoon its characteristic



THE BAGWORM IN HIS WINTER LOG CABIN

spindle shape. While doing this bulging in the middle the caterpillar gums the web inside with a kind of liquid glue which oozes through and hardens into a water-proof "rubber" coat.

HOW THE CABBAGE BUTTERFLY TAKES AN UPPER BERTH

Some of these Little People who take an upper berth in the sleeper — that is, hang themselves up — also have a curious way of strapping themselves in — as if they were babies in a baby-carriage. The cabbage-butterfly caterpillar does this, and its ways are worth knowing, not only because they are so interesting in themselves, but for the sake of the cabbages. The last brood of cabbage-caterpillars for the season make their cocoons about the time you start for school in the fall, and if you'll look around some nice sunny Saturday afternoon you'll see something that will make one of the best stories in the world for you to tell in school and write about during the following week.

In the weeds that are allowed to grow up in the garden toward the end of the season, the caterpillar that hatches from the little white cabbage-butterfly's egg, attains its growth in ten to fourteen days. When it is ready to go to bed for the winter it weaves a little carpet unusually thick in one spot. Then, having laid his carpet, like the contortionist in the circus — although I believe a helper does it for the circus contortionist — little Mr. Cabbage Contortionist proceeds with his performance. Watch him!

He walks over the carpet until his hind legs, which have hooks in them, catch in that thick spot. Then he pauses, as if to draw a deep breath or screw up his courage, or something. For next comes a very thrilling act; he lets go with all his legs except the two with the hooks, drops, and hangs like "the daring young man on the flying trapeze." And there he'll hang for many hours until you get tired of watching to see what comes next. But there will be others

that began their performance before he did, and you can see them do the rest of the trick. This is what you will see.

Hanging in this way keeps the body in a curved position which strains the skin on the back of the head. This strain



HOW JACK HELPS OUT WITH THE CABBAGES

This ichneumon-fly, shown very highly magnified at (a), pops into the world out of its cocoon (b) and then lays its eggs in the cabbage-worm. (Both worm and fly are shown in natural size at (c).) These eggs, hatching, live on the cabbage-worm; and the cabbage-worm dies. These flies are so useful that a specially effective species was imported from England in 1883 and has been helping raise cabbages ever since.

causes the skin to split, and out comes the chrysalis, slowly pushing back the skin as it emerges, so that finally it lies like a cast-off garment, but a little of it still covers the end of the chrysalis.

Now see how our little acrobat gets out of the last stitch of his day-clothes and climbs into the upper berth of his sleeper, as it were. He pulls the end of the chrysalis out

from the little heap of crumpled skin, reaches around, stretches up, and, after several efforts, reaches the silk button and sticks the hooks into it. But now, when the final hooking is done, Mr. Chrysalis, having no further use for the old skin and its hooks, proceeds to get rid of it, moving energetically back and forth until the skin drops.

HOW THE PASSENGER FOR DREAMLAND STRAPS HIMSELF IN

But, as if he knew the danger of falling out of his berth, our little passenger for dreamland takes the precaution to strap himself in before changing his clothes as described; and this performance is even more striking than the other. After his hind hooks are fastened in that button, he spins a silk thread, and, turning his head, fastens it to his support. Then, raising his head and the front part of his body, giving himself the quaint appearance of a dachshund looking up at its master, he hooks this thread over a pair of his front legs, and, moving his head around, fastens the thread on the other side; and so back and forth until a little silk strap is formed. Then with a quick movement, like a boy slipping his head through the collar of his sweater, he slips his head through the loop, and thus held safely by his loop and by his hooks fastened into the silk button at the rear, he goes through the rest of the great circus act which I have previously described.

DIFFERENT STYLES OF BEDCLOTHES

Silk for bedcovers is very popular among the caterpillars, but, as with us, there are differences in taste. Some use mixed goods. Certain caterpillars, for example, weave hair taken from their bodies into the meshes of the silk,

which helps to give it strength, saves silk and uses up old goods — the haircloth suit that would otherwise go to waste. If that isn't carrying out Mr. Schwab's idea of "making the most with what you have," I'd like to know how you'd do it! If you want to see it done watch the larvæ of the tiger-moth.

IN PUSSY'S GLASS HOUSE

While you're out in the woods looking for cocoons, I wish you would make a point to call on Miss Puss-Moth in her glass house. This is her winter residence. You'll probably have trouble in finding her at home, not because she isn't in but because you can't find the house! When the caterpillar of the puss-moth decides to retire for the great change sleep, it gnaws a depression or enlarges a crevice in the bark of the tree on which it lives, and over this builds a kind of skeleton net of silk. The bark which it has gnawed from the tree in digging what we may call the "cellar" of its house, the caterpillar uses to cover it; to "shingle" it, so to speak. It fastens on these "shingles" with its liquid silk, which afterward sets very hard. This covering is so much like the rest of the bark on the tree that you might be looking right at the little house and not know it; but if you put the caterpillar in a glass jar where it can get no bark, you will see that the house it makes is almost as transparent as the glass itself.

THE MUMMIES UNDER THE GROUND

The caterpillars of most owlet and hawk moths go to bed in little earthen pots underground. You will find their

chrysalides in September at a depth of six inches or more. In getting ready for winter they burrow down and then push the earth in all directions, so that it is packed into a ball; a cell so solid that the fall rains and the winter freezes and thaws and the spring downpours don't break it up. Dig up some of these cells and among them you will find some caterpillars that have just retired and you can see how the change to the chrysalis is made. As the change comes on, the caterpillar gradually grows shorter. Then you will see it twist and squirm until the skin opens in a straight line just behind the head. Then the pupa in its case, which is really doing the squirming, emerges. The case is at first covered with a thick, smooth substance, which, like oil in machinery, helps the case to slip out. This substance then hardens into a glossy water-proof covering. At first it is a brownish green, but rapidly darkens in color to a deep brown.

Fall and late summer are the best times for hunting cocoons because, if you wait until later, you'll find a number of hunters have got ahead of you — field-mice, squirrels, jays, and crows. They think a chrysalis is a dainty morsel.

YOU TRY THEM LIKE A MELON

And even after you've found a cocoon there may be nobody at home; the cocoon may be empty. You can tell a sound cocoon very much as you tell a ripe watermelon — by the thump; only it's the cocoon itself, if it's a sound one, that does the thumping for you! Hold it to your ear, and with a quick motion reverse it, end for end. If you hear a dull, solid thump, the cocoon is alive and healthy. If, on the other hand, it gives out a sound like a seed rat-

ting in a pod, this means that the caterpillar has been eaten by a parasite.

In gathering and carrying home your cocoons you must be careful not to crush them. And you must sprinkle them occasionally, because, being out of doors, they are used to more or less moisture. But they mustn't be kept too damp, otherwise they will mould. An ordinary living-room, on the other hand, is too warm for them. They can be laid on a small wire-net frame, over a pan of wet moss. They should be kept in a cool place with plenty of ventilation. Remember what a breezy place all outdoors is!

Nothing is to be feared from low temperature, but frequent and great changes are to be avoided. To be sure, there are frequent and great changes in the out-of-doors, but your cocoons will be leading a kind of artificial life, you know. One of the best ways to keep them is to pack them loosely between folds of cotton and put them in the refrigerator until April or May. If you keep them in the cellar they should be covered with wire netting. Remember what I said about field-mice. Well, house-mice find a nice fat chrysalis just as toothsome!

THE PLEASURE OF THE CHASE

Hunting cocoons shares, with other forms of hunting, the delights of the chase, for, as you have seen, some kinds are not so easy to find. Moreover, there is the pleasure of knowing that, in this kind of hunting, you are not causing pain to any living creature, and by keeping the cocoon until the sleeper awakens with its wings and its beautiful dress on, you will get a peep into the fairy-land of insect life. The transformation is as wonderful as that made by

the fairy godmother when she waved her wand that time and changed the pumpkin into a grand coach and the mice into horses to draw it!

HIDE AND SEEK IN THE OPEN

(STRANGE AND CURIOUS THINGS TO BE SEEN IN THE LAND OF THE SIX-LEGGED IN DECEMBER. CONSULT INDEX ALSO UNDER "MONTH BY MONTH")

Up in the attic there Mrs. Wasp has, as a fellow lodger, a fly — several flies, perhaps — although comparatively few flies survive the autumn frosts. Those that are not killed hide in crevices and under wall-paper in the house, in cracks in barns and outbuildings, and in crevices and under the bark of trees. On unusually warm days, even in midwinter, they often venture out, looking thin and run-down generally; for, like Br'er Bear and other hibernating animals, they live through the winter on their accumulated fat. But while Bruin comes out in the spring "as cross as a bear," I don't think I ever saw a cross fly. The fly people seem to be satisfied with making other people cross!

By the way, do you want me to tell you something that one of these thawed-out midwinter flies can teach you? It can teach you how an insect walks. Does it move all three legs on one side and then all three on the other, like a pacing horse? Or does it move the first leg on one side in company with the second leg on the other, as a horse does in walking or trotting?

Because your midwinter fly walks slowly, like a man in the movies as shown by the speedograph, you and another boy can thus see just how Mr. Fly's legs move in walking. One of you get on one side and one on the other, and report which legs are moving at a given moment, and see how the movements on the two opposite sides correspond. Then look among the answers in the January "H. and S.," and see if you have observed correctly.

While the flies only come out in the warmth of a room, not only the butterflies referred to in this chapter, but the springtails and bristletails hidden under boards, logs, and stones appear in the out-of-doors. The springtails and bristletails sometimes appear on the snow, as do the snow-fleas which cut such a figure in scientific

discussion about the Old Aristocracies of Insectdom, as will be told in the January chapter.

If you see some of these springtails out for a winter recess, catch one, look at him under your hand lens, and you'll see a way of getting over the ground even more interesting than that of the average insect, because it is so unusual. You'd suppose Mr. Springtail was training for an athletic field meet. He's a regular pole-vaulter! (See January answers.)

But, speaking of ways of getting around, do you know about the walking-stick that walks? The eggs of the walking-stick insect lie in the ground under the trees all winter, so that, when they are hatched by the warm spring sun, the larvæ can climb up and begin eating the leaves. The relatives of our walking-sticks in the tropics have wings, but our northern walking-sticks do not. These queer creatures are brown or green, and look so like twigs that they are rarely noticed, even when there are a great many on a tree. They feed on the leaves of almost all kinds of trees. Sometimes they are so numerous that they strip the trees. Doctor Lutz says he has heard them dropping their shot-like eggs so fast it sounded like a shower of rain!

The ordinary temperature of a room agrees with them, and they are very interesting "pets" to observe.

To see the stick insects hitching along in their jerky, stiff-jointed fashion, you'd think they had rheumatism from sitting around in damp places! Sometimes you'll find specimens three inches long. In the tropics they have them a foot long! Those species that have wings keep them so tightly folded when at rest that you wouldn't know they had wings at all. Some have spines on them that look like thorns. Others seem to say:

"I'm not only a stick but an old dead stick — good for nothing you might want to use me for; so just let me alone!"

Such walking-sticks have moss-like growths on them, just as an old, decaying twig often has. Of a species in Central Africa, Bastin, the English naturalist, says: "Take two inches of dried yellow grass stalk, then six more, nearly as long and a quarter as thick; bend each in the middle and at all sorts of angles, stick them in three opposite pairs (at more angles of all sorts) on the first grass stalk, and you have the member of the walking-stick family known as the Chirombo. The limbs are twisted at every angle, as if the creature were a long stalk of delicate grass crushed into a dishevelled heap."

And, like other members of the dramatic profession in the world of insects, it is an actor! "Having assumed a pose, it does not move or vary the angles of its body or limbs by half a degree."

The larvæ of the great family of Measuring-worm Moths are nearly all stick-like in form and color, and most of them assume appropriate attitudes when at rest. Most species of these caterpillars probably feed at night. When daylight comes some take firm hold on a twig with a few of their legs, and stretch out at an acute angle. It would seem as if they must have heard of the straps and the strap-hangers in the New York subway, for many species, to lessen the strain of this posing, spin a delicate silken thread from their mouths to the stem. (The subway passengers don't hang by their teeth, to be sure — as yet!) Some Swallowtail butterfly-caterpillars do this. They feed on a variety of plants, and often there are many of these little gymnast-actors performing in your garden, and you, looking right at them maybe, don't see them! Truly this *is* a silent drama!

The cocoon of the Prometheus Moth, attached to its leaf hammock and swinging in the winter winds, is still harder to find, unless the wind, as it sometimes does, has loosened the leaf. But nothing less than a good strong pull will free the cocoon itself, and often you'll have to use your jack-knife.

The Red Admiral Butterflies have two ways of passing the winter. Those that have wings at that time hide away in crevices, while those that are still in the caterpillar stage make themselves those little tents of leaves carefully fastened together with silk. Often, but not always, they bite through the stock of the leaf, so that it hangs down and withers. This withered leaf, turning brown, forms a background for their dark-brown chrysalides, so that even if some rude wind does expose them to view they are not likely to be noticed.

Apparently these little actors of the Insect World know about scenery and drop-curtains, too!

The cocoons of various species of "leaf-miners" are to be found attached to leaves or twigs. Some species go to bed in a case which they cut from the outer skin of the leaf and attach to the tree trunk. One kind makes cylindrical dark-brown cases on hickory leaves; another a flattened case with toothed edges on hazel leaves; another, dark-brown flattened cases on the leaves of apple-trees; another a scimitar-shaped case, two-thirds of which is white, the rest black,



Courtesy of Ginn and Company

LIKE A LEAF, BUT WHY SO MUCH SO?

You'd never think it was anything but a leaf if you saw it on a tree or a bush, would you now? But what will you say when I tell you that if you looked at it with a microscope you would see that it reproduced the features of a leaf even in minute details invisible to the naked eye? What is this for? It doesn't protect the insect. Birds don't carry microscopes! This minute imitation presents one of the puzzles within the great prize puzzle called "evolution."

on oak leaves. The moths hatch out of these cocoons from May to July, according to weather and climate. The larvæ from the eggs they lay go into the mining business by digging tunnels between the upper and under surfaces of leaves, and eating the substance out of them. The leaves of almost everything that grows

have some type of leaf-miner. As Lowell expresses it in one of the favorite poems of school-days (looking at it from an insect's standpoint):

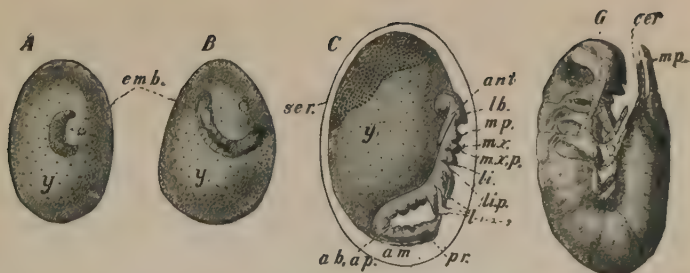
"There's never a blade or leaf too mean
To be some happy creature's palace."

Almost every acorn found on the ground in midwinter contains one or more larvæ who belong to another group of miners, those that live in nuts and seeds. They are found in wheat, corn, and other field grains, and in potatoes; in the seeds of burdock, wintering in the burrs; in sunflower seeds; in the galls they make in the stems of goldenrod and aster.

Answers

The Halloween prank of the codling-moth caterpillar referred to in this department in October, consists in mixing bits of bark with its silk bed-quilt, so that the cocoon is less likely to be seen, because it isn't so clear where the bark ends and the cocoon begins.

And about the Viceroy. The answer is that it is quite a little smaller than the Monarch, has a somewhat different arrangement of spots and shading on the upper wing, and a narrow bow-shaped stripe across the lower wing. Birds are quick to note the family markings on birds of their own species, but a bird would have to be an entomologist to see the difference between a Monarch and a Viceroy; so, as the Monarch doesn't "taste good" the birds, it is believed, let both of them severely alone!



THE GREAT REHEARSAL WITHIN THE EGG

These stages in the development of the fish-moth within the egg furnish a striking example of the facts upon which the evolutionists base their theory of the origin of all animal life. "What is there at A," they say, "to foretell that the little crescent-shaped thing would ever turn into C and then into G? Other facts, equally obvious, prove that such changes rehearse the stages of change of earlier and simpler forms of life into the higher forms which we know to-day; changes which, the rock records show, originally occupied millions of years." The letters are the abbreviations of the scientific names of the parts of the insect.

CHAPTER V

(JANUARY)

NEW-YEAR CALLS ON A FEW FIRST FAMILIES

Things look pretty quiet, don't they — the bare white fields, the frozen ponds, the naked trees, and the world of the Little People all asleep?

But no — not quite all; for whom do you think I met in my tramp across country this bright New Year's Day morning? A member of one of the first families in insect society — the snow-flea. And he had a number of his friends with him — something like a million, I should say! The snow was covered with them, all dressed up in their orange-red suits. The snow-fleas are about as big as a grain of wheat, and at a little distance the vast crowds in

which they travel make them look like a broad red stain upon the snow.

As I said, they belong to one of the very old families among the insect peoples. Meeting them — particularly on the first day of a new year — set me to thinking about the beginning of things in The Land of the Six-Legged; and how, starting in life only a few million years ago with nothing, or next to nothing, in the way of wings or tools to work with, so many insects have become independently rich as spinners, weavers, fruit-dealers, meat-packers, and so on.

I. THE ADAMS OF THE INSECT PEOPLES

But how? How did they start in life and how did they get on? That's the great prize puzzle of science. If you should be the one to solve it some day, I don't dare think how great you would be; for then you might not consider it worth while to read my books any more or have these nice friendly chats with me — and I shouldn't like that a bit!

Yes, and I want to tell you something else, in connection with this puzzle. If you should happen on some horse-radish seed and send it to Luther Burbank, he'd send you a check for several hundred dollars; and if you should see a hive-bee — not a bumblebee — gathering nectar from a red-clover blossom — red clover, not white, remember — I don't know *how* much the bee-keepers of the country would give you, but it would be a lot!

Why it is so hard to find seed on horse-radish, and hive-bees on red clover you'll see. It's part of the Story of the First Families and the interesting theories as to how "first families" originate in the plant and animal world.

STORY OF THE WORM THAT PUT ON WINGS

We had a good deal to say in the last two chapters, you remember, about caterpillars. Do you know what a caterpillar is doing, according to the science people who specialize in these first-family genealogies? I mean any caterpillar, anywhere, at any time — in the mere act of *being* a caterpillar. He's reciting the first chapter in what, if it's true, is one of the most remarkable things in the whole history of the world, the history of how a worm put on wings.

Now whether the science people are right about this I'm going to leave you to judge; for I intend presently to "lay the whole case before you, Ladies and Gentlemen of the Jury," as the lawyers say. You may not agree with the Wise Men of Science as to how it all came about. But what of that? Indeed, it would be impossible to agree with all of them, they differ so among themselves as to some phases of what the many and curious facts they have dug out of the rocks and fished out of the sea and picked up in the gardens and the orchards and the woods really do prove.

Yes, and this may be one of the cases where the meanings of things that have been hidden from the wise and prudent will be revealed to a younger generation. In any event, it is this very differing as to how to solve a puzzle that sharpens one's wits; and the fun of the thing is to work it out together. Isn't that true?

Well, then, to get back to our early worm, the one who first put on wings. He must have been one of the Adams of his species — the great-great-grandfather of ninety per cent of the insect peoples; for about ninety per cent of all

the different species of insects in the world to-day have wings. Then, still farther back, there was an Adam, according to the wise men, who didn't have any wings; who was born and died a mere wingless worm. But as to how the winged Adam who descended from the worm Adam first put on his wings, and so set the fashion for his descendants, the wise men don't agree at all; not even as to whether he put them on all of a sudden, as one climbs into a flying-machine, or whether his flying-machine, like the flying-machines of human beings, was "invented," so to speak, in course of time, little by little. It is by this little-by-little process that men make their inventions, you know. That is how we got our flying-machines — by a continual "cut-and-try" from the myth days of Dædalus and Icarus down to the Wright Brothers.

But however long it took to develop the first pair of wings, the caterpillars of to-day do it in no time! And in passing from the caterpillar stage to the winged stage, they are supposed to be rehearsing, in a general way, the age-old history of their race. In a similar way the frog, in passing through the various stages of tadpolehood, retells, so they say, the genealogy of his honorable family and its origin in the water. The fact that a chicken, while still in the egg, has for a time gill-clefts, like a fish, is part of the evidence submitted by these science people to prove that birds descended from fish; and, according to this view, the fact that young robins wear speckled vests, which give place as they grow older to the well-known red vest of the robin clan, is simply nature's way of telling us that the robins belong to the thrush family — and so on with an endless number of facts like that.

“If,” say the science people, “these things don’t mean what *we* say, what *do* they mean? And if you don’t believe us when we tell you that all the evidence goes to show that the various forms of life — many of them now very different from each other — descended from one common stock, can’t you believe your own eyes? Can you imagine any two things more different than a caterpillar and a butterfly, for example? And yet don’t you see the one change into the other?”

THE RECORD OF THE ROCKS

The remains and imprints of insects of long ago which we find in the rocks show successions of related but different forms in successive ages. In the lowest and, therefore, oldest rocks, the forms are much alike, but they grow more and more unlike as we go up from the older to the later rocks. And the longer the time, as shown by the thickness of the rock beds, the greater the differences. In the lowest rocks we find the remains of the simplest insects — mere worms, like the caterpillar, or the body of the butterfly without the wings. Then in later rocks we find insects of similar form, but with wings.

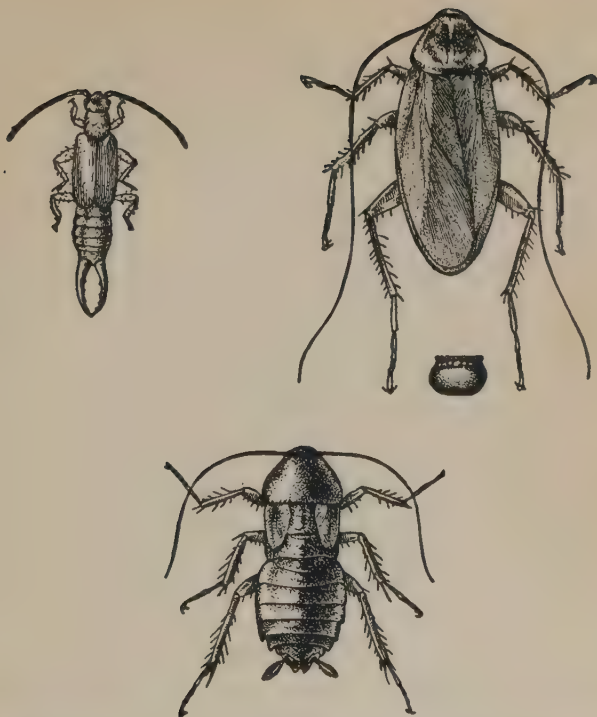
Now the winged insects of to-day, beginning as worms and passing to the winged state, are, as I said, supposed — according to the evolutionary theory — to be rehearsing this story of the millions of years of the upward climb to the higher life. Furthermore, we find insects still in existence that stop at various stages in the improvement of the insect make-up; insects that seem to have made the mistake of quitting school in the grades and never going into High and learning the art of flying and other useful

things. Among such are these snow-fleas. They have the six legs of the insect family, but the females have no wings, and in the males there are only the beginnings of wings; mere wing buds, you may say, that never blossom.

HOW DID THESE COCKROACHES LOSE THEIR WINGS?

On the other hand, these rock tombs of their ancestors show that some kinds of insects once had good, workable wings that don't have them now; for this development process, say the evolutionists, has its ups and downs. The cockroaches, for example, come of a very old family, and their great-grandfathers could fly, yet some of the modern cockroaches have no wings, and all prefer to trust to their nimble legs alone, so it seems, to keep out of the way of the indignant housewife. That the wings of some species of cockroaches are now useless is an unquestionable fact, but the question as to how they became useless and, in the case of some species, disappeared, is the subject of some of those interesting theories I have referred to. One theory is that such things as wings and other bodily organs are sometimes lost because their possessors, like the man with the single talent in the Bible, fail to put them to use. But another theory, which we will come to in the next section, when we stop for a while and listen to the discussions of these wise men, is just the opposite—that wings may be lost as family heirlooms because they *are* used.

As far back as the days when the waters still covered the face of the earth—or a good deal of it—there must have been some insects; for in the rocks of Canada have been found a few fossils of the wings of creatures related to



THE ARISTOCRATIC COCKROACH AND THE BROODING EARWIG

One of the authorities in bugology says of the cockroach: "If the test of nobility is antiquity of family the cockroach is a true aristocrat. He doesn't merely date back to the three brothers that came over in 1640 nor to William the Conqueror. Man himself is but a creature of the last twenty minutes compared with the cockroach. From its crevice behind the kitchen sink it can point its antennæ to the coal in the hod and say: 'When that was made my family were already well established.'"

Our illustration shows two members of this distinguished family and a no less distinguished relative, the earwig. On the left is *Periplaneta americana* and its egg in its case. On the right is an earwig and between the two is another cockroach, *Blatella orientalis*. Only the male *B. O.* gets wings, and these are no good for flying.

Earwigs are so called because of an old English superstition that they creep into people's ears and kill them. A much more interesting truth than this silly superstition is the scientific fact that earwigs sit on their eggs and brood their young. They sit on their eggs, not to hatch them, however, but to guard them.

the May-flies; but several million years later, when Mother Nature was putting in our coal-supply, that is to say, in the Carboniferous Age, insects had become quite common. The forms of these frail creatures of a day are frequently found immortalized in their imprints in the coal. These imprints are not so numerous that you would be likely to find one in the coal bin, but go to any museum and you will see them. Among these pictures in the family album of the Coal Age are those of folks evidently related to the cockroaches, but with real wings instead of the little useless wings that modern cockroaches wear. There are also remains of gigantic insects related to our dragon-flies, but with wings that measure two feet across, outspread. I wonder if there were ever any mosquitoes of that size. Imagine a mosquito with wings two feet across! If there ever was such a creature she must have had a hum like a Liberty motor. And her stinger — but don't let's think of it!

With the opening of the next great chapter in the history of our continents and their six-footed citizens, come insects that are somewhat more like those of to-day. In Colorado, for example, have been found fossils of cockroaches that, in general style, are about half-way between the fashions of the Coal Age and those of to-day. In the succeeding age we first come upon the ancestors of our ants. It was millions of years after this that the world first began to be troubled with flies. Along with them came the bees, the butterflies, and the moths.

And — a most wonderful thing — just before the bees arrived there came into the world the flowers, as if they *knew* the bees were going to need them in carrying on their

business; and as if they knew what a help the bees were going to be to *them* in carrying on *theirs*!

Yes, and if it hadn't been for the bees and the flowers where would *we* have been, with no apples, no pears or peaches or oranges or any kind of fruit! So wasn't it lucky for all of us that the flowers and the bees "happened" along about the same time?

But do you believe it just happened? I don't! Ask father if his watch ever *happened* to wind itself. He'll think that's a funny idea, and I think so too. Don't you? How such things as the coming of the bees and the flowers at just the right time could take place, and why these flowers should change more and more from age to age, to meet the requirements of the bees — they did *that*, too — without a Guiding Mind behind it all, none of the Science Wise Men have ever been able to say; and, in my opinion, they never will be able to say.

"WHO WAS WHO" AMONG THE ADAMS?

The science people believe that all forms of life developed from some much simpler ancestral form. And they say that those insects in which the greatest difference exists between the form at birth and the form of the grown-up — as between a caterpillar and a butterfly — were the latest to branch off from their family tree. They include in their own life history more of the ancestral forms — resemble more of their different grandparents, as it were — because they had more different grandparents to resemble.

Yet the scientists differ widely as to how these changes came about, and they do not agree, as I said, as to just "who" the first Adam of the insect peoples really was.

This first Adam, whoever he was, was the trunk, according to the evolutionary theory of the origin of species, from which branched off descendants in two directions; in one direction into insects and related forms, such as crawfish and spiders,¹ and "thousand"-legged worms, and in another direction into such creatures as the many-armed octopus. Some, for instance, say the larva, the worm stage of such insects as the butterfly, looks most like the original Adam; others think he looked more like our bristle-tails and springtails, which are born as wingless creatures with six legs and stay that way all their lives.

But whether first honors finally go to the springtails or somebody else, how true it is that the insect peoples — any of them — when you come to speak of old aristocracies, are so far ahead of even the most ancient of the lines of kings that they are not to be mentioned in the same breath! Those old Pharaohs might well have been proud to lie down for their long sleep with the sacred beetle, carefully wrapped in their winding-sheets, for a bedfellow!

II. A LITTLE VISIT WITH THE WISE MEN

You know how much fun it is to try to work out even an ordinary puzzle — an acrostic, a cross-word enigma, and so on. Now suppose you had before you a page where the answer to *each separate puzzle* had to fit into a certain place among the answers to *all the other puzzles* on the page or you couldn't get what I may call the Grand Answer at all! This puzzle of the family history of insects and things

¹ A spider isn't an insect, but you can see he looks a great deal like one.

is just that kind of a puzzle. In short, this puzzle is so hard to answer and so fascinating to *try* to answer that I don't think you were much surprised to hear that grown folks — I mean the science people — have been sitting up nights for a long time trying to work it out.

This puzzle has all the charm of a continued story. It keeps them wondering what's coming next. One thinks a certain part of it is going to turn out one way and says so — you know how people are when they read a story together. Another thinks otherwise. And half the time it turns out in quite another way altogether; in a way none of them ever dreamed it would.

So you see this puzzle, just because it is so big and interesting, is something you are going to hear referred to a great deal, and when you do you would like to know what people are talking about, wouldn't you?

The general name for the whole puzzle and for the various answers submitted is "evolution." But, after all, this name is little more than a label for a collection of facts, some of which seem to point one way and some another, as to *how* the evolution comes about; although as to evolution itself, the development of one species out of another, practically all scientists agree. What makes the whole thing still more interesting is that there is frequently more than one answer to the same problem. Yet these answers, although they may seem at first to flatly contradict each other, may both be right.

THE CASE OF THE COCKROACHES AGAIN

Take the case of the cockroaches, which, as the remains of their ancestors show, once had good first-class wings.

The lack of such wings in some of the cockroaches of to-day may be due to the fact that their ancestors neglected to use them, and so they withered away; or it may be due to an exactly opposite reason — namely, that they *did* use them! For instance, suppose a race of winged cockroaches on an island in the sea. Just as boys, even of the same family, differ in the size of their limbs, so insects of the same kind vary in the size of their wings. Now, in the case of our insects on the small island, the ones with the biggest wings would be most likely to be blown to sea by strong winds and lost, as poor Icarus was; while those with shorter wings would be constantly winnowed out and left to perpetuate the race. And those that survived in greatest numbers would be the ones with wings too short for flying or with no wings at all!

So say some of the wise men, and they call this winnowing-out process the law of “natural selection,” or of “the survival of the fittest.”

“Ah! but wait a minute! Not so fast!” says another wise man. “A short-winged insect is just as likely to mate with a long-winged insect as with one of its own pattern; so this short-wingedness would be constantly swamped by interbreeding.”

“Pooh! That’s nothing,” replies Wise Man No. 1. “The shorter-winged would be constantly winnowed out by the winds just the same, and so the standard of wings would keep getting lower and lower.”

“Yes, and there’s another thing,” says Wise Man No. 3, who evidently agrees with No. 1 on this point, “you talk as if you had never heard the Story of the Bob-Tailed Cat.”

No doubt Wise Man No. 2 has heard it — for the wise

men usually know all these classic stories of science, but, like other people, they often still stick to their own theories and ignore the facts presented by those who have different theories. But as we don't know this story we'll ask about it.

"Please, Mr. Wise Man No. 3, what *was* The Story of the Bob-Tailed Cat?"

THE STORY OF THE BOB-TAILED CAT

"Why, just this," says he. "Once upon a time a cat was born with a very short tail. And she had a litter of kittens. Then, in the course of her lifetime, five more litters. And in all these litters there was a total of four bob-tailed kittens, twelve with tails of the usual length, and twelve with no tails at all. Doesn't this show plainly enough that short-tailedness, when once it gets started, not only survives interbreeding, but sometimes results in absolute taillessness? Now why shouldn't this be equally true of an island insect shortening its wings?"

"Furthermore," says Wise Man No. 4, who also has been working on this phase of the puzzle, "there are the principles of the Natural Selection and the Survival of the Fittest, which would apply to those island insects. In the case of the bob-tailed cats these principles or laws wouldn't have any effect, of course; unless we can imagine it would be an advantage in the struggle of life among cats to have a shorter tail."

"Some of you people go so far as to say it *would* be an advantage," says a man in the audience who doesn't believe in evolution at all. "The argument is that because less of the cat's substance would be used in keeping up the useless

expense of a tail, this material could be worked up into stronger muscles! But I don't call *that* argument. It's merely a wild fancy. That's why I don't take any stock in the evolutionary theories."

"Because some of the theories don't appeal to you," replies Wise Man No. 4, "you reject them all! Well, every man has his own way of looking at things. But even suppose you *do* reject all the *arguments*, what are you going to do with the *facts*? If you don't like the conclusions men of science draw from these facts, draw your own."

"That sounds fair and reasonable," says another man in the audience. "I'm on the fence, as the saying is, on the evolution question. I want to know the facts and the conclusions that have been drawn from them, because, for one reason, evolution is a thing one is constantly coming across in reading and in the conversation of educated people; and, for another, whatever the established facts are that is what I want to know; then I can draw my own conclusions. Now, let me ask a question. Do you mean to tell me and do you mean to tell these young people (he has evidently noticed us in the audience) that if you bobbed a cat's tail or even the tails of cats for several generations, you'd get a race of bob-tailed cats?"

WHAT IS "SPONTANEOUS VARIATION"?

"No, I don't mean that at all," replies Wise Man No. 3. "Most of the evidence goes to show that peculiarities to be inherited must be what are called 'spontaneous variations.'"

(Ask him what a "spontaneous variation" is. It's *your* turn; I asked the last question.)

"Please, Mr. Wise Man No. 4," you say, "what is a spontaneous variation?"

"Well," says he, "a spontaneous variation is just that; it's a variation, a peculiarity, that comes 'of its own self,' as a boy might express it. It means that a plant or animal is *born* that way — as in the case of the cat with a short tail and her kittens with no tails at all. We don't know how such variations come or why; although we have learned a good deal about the *conditions* under which they come and how to preserve and cross these peculiarities in breeding plants and animals. All the wonderful things Burbank has done in the way of producing new kinds of fruit and flowers and vegetables and nuts are based on his knowledge of certain evolutionary laws and his extraordinary skill in using this knowledge."

LOOK OUT FOR THE SEED AND THE BEES!

"He knows, for example, that horse-radish, having been bred so long from cuttings instead of seed, now seldom bears seeds at all. And he offers to give several hundred dollars for a little horse-radish seed when found, as it sometimes is. Plants which are accustomed to being raised from cuttings, tend, when raised from seed, to go back to the wild form. This being turned loose in the wild, as it were, is one of the conditions that results in variations; and variation is what Mr. Burbank wants, so that he can select any variation that may prove useful."

"So," continues our friend the Wise Man, "keep your eyes open for horse-radish seed. And while we are on the subject of the money value to you of helping the good work of evolution, look out also for hive-bees on red clover.

The average bee never visits red clover because its tongue isn't long enough to reach the nectar, but occasionally a hive-bee is seen in a red-clover field. If any boy should notice a bee so engaged, he should watch closely to see toward what hive she makes her 'bee-line.' Then it will probably be found that the mother queen of the hive will have *many* long-tongued bees among her children; since, as we have seen in the Story of the Bob-Tailed Cat, such peculiarities run in families. From these a race of long-tongued bees could be established in a few years, and tons and tons of honey be saved that now goes to waste."

As we listen further to the discussion we learn many interesting things; among others that the Darwinian theory, the most famous of all the theories of the *process* of evolution and the one that was at one time almost universally accepted by men of science, is now widely discredited in its two most vital features; although the facts he collected to show that evolution of one species out of another actually does take place *somehow*, are still as universally accepted. Darwin was one of the greatest of all the world's great men of science, and as good and lovable as he was great. He also contributed many important things to our knowledge of science, in addition to what he did in obtaining a wide acceptance of the idea of evolution among educated people. But to believe in evolution — that is, that one species grew out of another, instead of being separately and independently created — to believe this is *one* thing and to accept the theory of Darwin or any one else as to *how* these species originate, the process of it, is quite another thing.

One of the two essential features of Darwin's theory that

are now criticised is that of the "survival of the fittest" in the struggle of life. It is obvious, to be sure, that any variations which would help in the life struggle — as a longer neck in time of scarcity of food for giraffes, or shorter wings in the case of the cockroaches on a little island —



VARIETY AMONG THE CANES OF SEEDLING BRIERS

would tend to perpetuate the species having these advantages. But it doesn't account for the innumerable variations in animals that have nothing to do with the struggle of life, such as the beautiful patterns which distinguish the wings of different species of butterflies. Moreover, experience, including that of Mr. Burbank, shows that most variations occur where the conditions of life are most favorable, where there is the least struggle for existence; as among plants in rich soil, where there is plenty of room and plenty of food for all.

THE STEADY UPWARD MARCH

The other of the two main features of the Darwinian theory that is now widely questioned is that purely *accidental* and random variations should result in the formation of new organs; wings, for example. The most striking fact about present-day scientific thought on evolution is that the men who study the life of past ages in the record of the rocks are practically agreed that while many variations occur apparently at random, nevertheless there are variations, from time to time, that not only affect whole groups but follow definite lines, leading to higher forms of life. The rock records show that the higher forms followed the lower forms, as time went on, and that, last of all created things, came man. Just as it says in the first chapter of Genesis, and as Tennyson says in those grand lines:

“Throughout the whole creation
An unceasing purpose runs,
And the thoughts of man are broadened
With the process of the suns.”

“So,” says one of the wise men, “whether you believe it because the Bible says so, or because the poet says so, or because science says so, this fundamental theory of evolution as a constant *upward* movement is true — the greatest and most inspiring truth in science.”



A BR'ER RABBIT WITH SIX LEGS. HOW THE SPRINGTAIL JUMPS

HIDE AND SEEK IN THE OPEN

(STRANGE AND CURIOUS THINGS TO BE SEEN IN THE LAND OF THE SIX-LEGGED IN JANUARY. CONSULT INDEX ALSO UNDER "MONTH BY MONTH")

January would seem to be a queer time to look for live grasshoppers, and I don't say you'll find any, but you may. A few grasshoppers sometimes hatch from fall-laid eggs if the season is unusually long and warm. Then, when Jack Frost comes along they hide away, and on mild winter days these sturdy, half-grown youngsters are occasionally seen, hopping about on the snow.

And what do you think of laying eggs in midwinter? The moths of some species of canker-worm sometimes come out and lay eggs during January or February thaws — a part of their artful-dodging system, I suppose!

Look for the chrysalides of the Polyphemus and Luna Moths under the trees where their caterpillars fed last summer. The caterpillar of the Luna feeds on walnut, hickory, persimmon, sweet-gum, and other trees. The cocoon is usually made between leaves on the ground. It is very thin, and rattles when pressed or when the pupa moves. The caterpillars of Polyphemus feed on oak, maple, birch, and a great variety of other leaves, but on oaks and maples most frequently. There are two generations of the Luna each season, but only one of the Polyphemus. The cocoons of Poly, although made in the trees, frequently fall to the ground, but this is by no means always the case, as many books say. The cocoon, which is more solid than Luna's, contains a long, unbroken, easily unravelled thread of silk which, says Doctor Lutz, would be commercially valuable if labor were cheaper.

Do you want to find a cocoon that is the home not of one but of hundreds of future moths? Then look on the bark of elms and maples for the cocoon of the Tussock-Moth. On the roofs of the old homestead (the cocoon out of which their mother was born) you'll find about thirty dozen eggs of the white-marked Tussock-Moth; bakers' dozens, and very generous bakers' dozens, too, for she usually lays about 400.

You've often seen the Tussock-Moth caterpillars on our shade-trees — they are all too common for the country's good. They have four white tussocks or clusters of hair, like little shaving-

brushes, sticking up out of their backs. They make their grayish cocoon on tree trunks, in the corners of rail fences, and in other nooks. The female moth, hatching, lays her first batch of eggs on the cocoon from which she herself was born, protects the eggs with a firm, frothy-looking covering, and then dies. In the spring the eggs hatch and you'll see the red-headed caterpillars, in their yellow-and-black-striped suits, busy everywhere among the shade-trees.

And if there is a swing on one of these trees you can notice little Mr. Tussock keeping you company when you're swinging; for one of his favorite amusements is to spin a long thread, hang by it from the tree, and allow himself to be swung by the breezes!

But in spite of the fact that they lay so many eggs, the Tussock-Moths aren't so hard to get rid of as you might suppose. Since the females have no wings, if you once get a tree freed of them it may be kept free by banding it with sticky paper.

Another thing about it is that you have a good deal of help from other insects. There are more than twenty different kinds of insects that prey on the Tussock-Moth; and as many as ninety per cent of the Tussock-caterpillars and pupæ in some seasons are thus destroyed. But, unfortunately, there are fourteen other kinds of insects that prey on the insects that prey on the Tussock! But, again, there are also other insects that prey on the insects that prey on the insects that prey on the Tussock!!

The Department of Agriculture at Washington imports these policemen whenever it can find them. It is now introducing certain policemen from Europe to help keep the Gypsy-Moth in check. This Gypsy is even more prolific than the Tussock. Although the female has pretty good wings, she rarely flies, and she lays her eggs not on the chrysalis shell, as the Tussock does, but near by. They are yellowish, nearly round, and laid in masses of from 200 to 1,000 and more, and covered with buff-colored scales, which the mother takes from the under side of her body, much as a mother rabbit lines her nest with her own hair. You'll find the cocoons of the Gypsies not only on vegetation but under overhanging stones, on fences, outbuildings, farm-wagons, and railroad-cars that have stood on sidings in country towns.

Yet with all this the State and national Departments of Agriculture have fought "for the common defense" so wisely and so well — although it has cost millions of dollars to do it — that the

destructive work of the Gypsy has been largely confined to New England, where it was accidentally introduced by an amateur student, in some cocoons of insects he obtained from Europe.

If you should see something which you think may be the Gypsy-Moth in any of its stages, you will be doing a fine piece of boy scouting if you will send it at once to your State entomologist or to the Bureau of Entomology at Washington. It will then be known that they have invaded your section, and measures can be taken against them. The male Gypsy is olive-brown, the female whitish brown. Adults appear from June to September, but most abundantly in July. The caterpillars hatch in April or May.

Remember that the Mourning-Cloak Butterflies and other species that go to bed with their wings on, are to be found in wood-piles, brush-heaps, hollow trees, and other shelters. If they don't come out on sunny winter days hunt them up, invite them into the house, and then invite your friends to a New Year butterfly ball.

Live butterflies in winter! It doesn't seem possible, but it's true. It doesn't seem so hard to realize that the ants far below the frost-line are busy in their housework and their dairying — tending the aphids or their eggs; or that the larvæ of certain wood-working beetles are getting their regular meals — the Longicorn and Buprested Beetles, for example, which are boring away, deep below the bark of trees and logs.

A very interesting member of the beetle family is the Click-Beetle. Of course, you can't hear him click or see how he does his clicking at this time of year, because, either as a "wireworm" or as a pupa, he is now asleep in the soil, but remember to turn back to this page when summer comes again and then watch him perform. The Click-Beetle got its name from its original way of rising to its feet when it happens to land on its back, as it frequently does. The head section is very loosely jointed to the rest of the body, and when Click finds himself wrong side up, he arches himself backward, and then, suddenly straightening up, bounces into the air, turning over as he goes. To prevent their heads from bending too far forward during this act, there is a little projection under the front section of their bodies which slips back into a groove in the second section, like a dagger into its sheath, and in so doing makes a decided click. The springtails that are sometimes seen on the snow on sunny days have another way of jumping. Those two

things sticking out like tails they bend under their bodies and then, suddenly straightening them out again, away they go!

On hazel and alder bushes in winter you'll find certain curious things that look like little packages done up in brown paper; as if some clerk of Fairy-Land had left them to get a piece of string and failed to come back. If you watch when the packages are being done up, along in July, you will see that the reason the tiny brown beetle that does the work doesn't use any string is because she doesn't need any. The artist-naturalist, Gibson, tells how she manages it. She first bites through the leaf to the midvein, close to the stem and partially through the midvein, also, leaving barely enough of it to hold the weight of the leaf, which soon withers in the hot sun, and in this limp condition is just right for rolling. She folds the leaf face to face along the midvein, pressing it together between her legs. She then lays a tiny yellow egg at the extreme tip of the leaf and standing sideways, and holding firmly to the leaf with her three legs on one side, passes her other three legs beneath it on the other side and starts to roll it, taking a fresh grip with each successive turn. On reaching the point where the leaf is attached to the twig, the cut edge of the leaf, previously referred to, is turned backward to overlap the last fold of the coil, thus holding it in place.

Answers

HOW AN INSECT WALKS

An insect walks like a couple of three-legged stools out for a stroll, moving the first and third legs on one side in company with the second leg on the other. A horse or a cow or a dog walks or trots in practically the same way — moving the first leg on one side in company with the second on the other. And, by the way, don't we make the same combination of limb motions in walking; swinging the right arm forward with the left leg and the left arm forward with the right?

WHY THE MEASURING-WORM MEASURES

The measuring-worms, you'll notice, have legs only at each end of the body, while other caterpillars have them all along. The consequence is that the measurers have to hump themselves along in that funny way, taking hold with the front legs, then pulling the

hind ones up to them, then holding on with the hind legs while the front section moves forward again. Awkward and ungraceful as this way of walking seems to us, it is evidently very popular in Caterpillar Land. Over a thousand species of measuring-worms have already been identified in the United States alone.

HOW THE SPRINGTAIL SPRINGS

(Answered in fourth paragraph above.)



SEE WHY THE MEASURING-WORM "MEASURES"?



Copyrighted by Harper & Bros.

THE QUEEN ANT AND CIRCLE OF ATTENDANTS

CHAPTER VI

(FEBRUARY)

WASHINGTON'S BIRTHDAY AND THE INSECT REPUBLICS

It sounds odd — I'll admit it — to speak of Washington's Birthday in connection with the insect republics, but when you hear what I'm going to tell you now and know that I mean, not *George* but *Martha* Washington, it may not seem so odd; and since this is the month when we celebrate the birthday of the father of *our* republic, I thought it would be nice if, in our little family chats at home and in school, we talked also about the republics of The Land of the Six-Legged and their history, their patriotism, and their form of government, their police system and all.

Quite aside from the many curious things to be seen, we can learn much from these little citizens and their conduct of national affairs that might well furnish lessons in the conduct of our own. We'll find no corruption in office, no graft, no tax dodging, no shirkers.

There are some things, to be sure, that could be improved. The hive-bees, for example, overdo the swarming business — sometimes make a perfect fad of it, and there's a lot of good red-clover honey that goes to waste every year — tons and tons of it — because so few hive-bees have provided themselves with long-enough tongues. But our modern efficiency engineers are improving these swarming habits, and with your help, as suggested in the last chapter, they will be able to take care of the long-tongue problem. By backing up the bee policemen the bee-keepers are greatly reducing the number of burglaries — for while, as I said, there is absolutely no corruption in office in the bee republics, burglaries are not uncommon.

I. THE COLONIAL PERIOD AND "THE MORE PERFECT UNION"

How did insects ever develop such remarkable systems of government as we find among the bees and the ants?

This is one of the many fascinating mysteries in the history of these strange Little People. Just how it came about the science men don't yet pretend to say; or, rather, some say one thing and some say another — mere suggestive theories, you understand, possible solutions to be thought over. But on one point they all agree, and that is that the feeling that makes boys and girls want to be chums had a good deal to do with it. The brightest and best-organized

of all the insect folks — the ants, the bees, and the wasps and the termites, or so-called “white ants” — “have won their own way,” as one writer puts it, “by the development of family life and by working for and with one another.” In one bee-hive there may be as many as 50,000 — all members of one family.

BEES THAT DIE OF HOMESICKNESS

And do you know how much this big family life means to a bee? Well, it means so much that if you take a bee away from its hive and shut it up by itself, it will get homesick and will die — of homesickness!

In his study of the agricultural ants of Texas, Professor Wheeler of Harvard tells of a system of “first aid” in use among them which shows what kind hearts, as well as wise little heads, they have as a result of their family life.

Toward nightfall, as the cold December twilight was setting in and the ants were returning from all directions, each bore in its slender jaws some inexperienced and weary fellow worker picked up on the way.

In order that our minds and hearts may grow we must have companionship, so nature makes us hunger for chums as we hunger for food. It's the natural hunger for companionship that makes it so unpleasant to live in lonely places where one doesn't have any neighbors.

I was discussing the conditions of success in life once upon a time with a famous American painter, Elihu Vedder, and he said: “A painter, or a student — anybody who has to work things out — must be alone at times; and on days when I have been thrown out by a thousand little interruptions, I've thought how nice it would be to be a her-

mit. But there is a wonderful inspiration in the companionship and conversation of fellow workers, and if I were a hermit I should insist on being where I could have a lot of other hermits over at my place in the evening."

It's the companionship of work as well as mere social relations that is of special value, so we find the best instances of it among creatures of the same species. At the New York Zoo there is a sort of good-fellowship club of three members that always amuses visitors. It consists of a Mexican fox, a little monkey, and a coati—a South American relative of the raccoon. But now, notice the difference between this good-fellowship and the fellow citizenship in the insect republics, the United States of Beedom, for example. In the case of the monkey and his chums, instead of sharing the good things of life, each one takes precious good care not to! Give the monkey a lump of sugar and will he say to the fox or the coati:

"Brer Fox and Comrade Coati, won't you have a bite?"

No, indeed! He doesn't even offer to let them lick it! He runs to the nearest bit of water and dips the sugar, so that it will melt quicker, and then pops it into his mouth and bolts it down just as fast as ever he can!

This is not only bad manners; it's bad citizenship. You never could build up great nations such as those of the bees by acting in that way. You've got to think of other people and do things for them, or you needn't expect them to do things for you, and that's all there is to it!

THE STARVING PATRIOTS OF BEEDOM

But how is it with the bees? Just the other way! Not only does a bee work all day long, toiling over 200 to 300

flowers for the benefit of her fellow citizens of the hive, when the nectar from two or three flowers is ample for her personal wants, but where a bee-keeper, after a long winter, has allowed the honey-supply to run too low, the first bees of the starving colony to get out in the spring will carry food around to their companions in the hive, although they have hardly strength enough to stagger to them.

That's what *I* call patriotism!

And it's that sort of thing that has been the making of the great republics of the bees. But I am assured by the bee-keepers that Maeterlinck is mistaken when he says:

Bees abandon the old hive only when it has attained its highest prosperity. This is not a blind act, but a well-considered sacrifice of the present generation in favor of the generation to come.

The fact is, they swarm at such times because they can't do anything else. The old hive will not hold any more honey. Before getting ready to go, they have been known to store honey underneath the hive or under a portico, swarming and seeking new quarters only as a last resort. On the other hand, bees often swarm without any cause at all, apparently; just for the excitement of the thing. At such times swarm after swarm will come out while the first is in the air. As many as a dozen swarms have been known to come out and go off to the woods in a great army.¹

The popular idea that the ringing of bells or beating on tin pans has any effect in causing a swarm to settle has no

¹ There is always more or less swarming going on about July Fourth from very populous colonies—a kind of Declaration of Independence, one might suppose, but it's mainly because the hives are full of honey at that time.

foundation in fact. It originated in an old English law that when bees swarmed the owner must ring a bell or drum on a pan to notify his neighbors that his bees were out, so that no one else could claim them.

PROGRESS OF CIVILIZATION AND CITIZENSHIP AMONG
THE BEES

Don't think that the Little Folks of Lilliputland learned the great lesson that "in union there is strength" all at once, any more than the American colonists did. Take the bees again. Just as it is among human beings, we find bees still in very different stages of civilization; some leading a solitary life, each with her own little establishment; others in neighborly groups, but each attending strictly to her own affairs and never lending a hand; others living in rooms opening off a common hallway. Others carry the small apartment-house idea still further by having a common hallway and then corridors leading from this, and private rooms opening on the corridors, much as it is in a big hotel. But in all these cases each takes care of her own room, makes the bed, does her own marketing, prepares the meals for her own children, and everything.

But in these apartment-houses all work together in making the hallways and the corridors, just as our grandmothers worked together at a quilting-party. And so while two Mrs. Solitary Bee housekeepers, looking for a home to move into, may fall out, as we shall see when we come to the spring house-moving season, and have high words, don't you suppose it must be different in the case of these bees that live in apartment-houses or family hotels? They must learn from this community life how much nicer it is

to be polite; and politeness between peoples, as human history shows, is one of the beginnings of national life.

"Good morning, Mrs. Burrow-Bee, of Apartment No. 31! Lovely day, isn't it?"

"Yes, indeed! It makes one feel energetic."

Can't you imagine them saying such things as they meet at the common doorway, fresh from an early spin over the sunny fields?

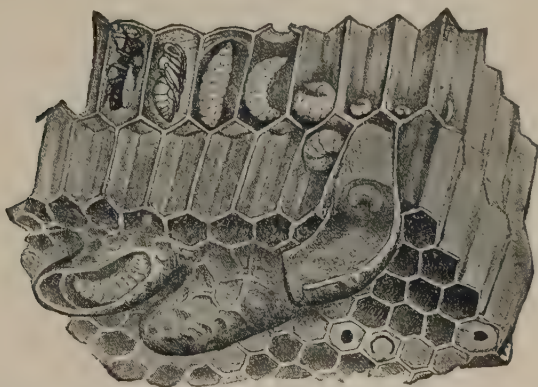
BEGINNINGS OF COMMUNITY HOUSEKEEPING

Still other wild bees have carried this community living into complete community housekeeping, doing their marketing together, getting their meals together, and all. These bees hive together in hollow trees, in the crevices of rocks, and such places. But even among them we find a condition which reminds us of that period of our own history before the colonies were united under one government. Instead of having only one queen, one head of the commonwealth, as among the highly civilized bees — the bees of our hives — these little confederacies of the wilderness may have more than a hundred queens. Our domestic bees produce only ten to a dozen queens at most, and of these only one is allowed to be the mother of her country.

The most primitive bees, such as the carpenter-bees and the burrowing bees, have no baskets with which to gather pollen. Later, when baskets were invented, the more advanced bees used them, although some continued to carry pollen by swallowing it. It is because she hasn't learned to make wax that the solitary bee burrows in wood or in the ground, or builds her little hut of clay.

As we ascend the family line in Beedom we also find the

tongues getting longer, enabling more honey to be gathered, stronger claws, hairs, and brushes for pollen gathering, stronger mandibles for shaping the wax cells, and a remarkable division of labor among the workers. For among the bees of our hives there is not only the division



SUCCESSIVE STEPS IN THE DEVELOPMENT OF BEE QUEEN CELLS

into drones, queens, and workers, but division of labor among the workers themselves. First of all, with the beginning of business in the spring, comes the work of the "consuls," who are sent abroad to report on commercial conditions. As Maeterlinck expresses it:

In the spring, day after day, beginning at sunrise, the hive awakens to receive the glad news of the earth. One day it is: "The grass of the roadside is gay with white clover." Then: "The lime-trees are overflowing with pollen." Whereupon the bees organize and divide the work. Five thousand of the sturdiest will sally forth to the lime-trees, three thousand of the juniors will go to the white clover.

CAN YOU ANSWER THESE CONUNDRUMS?

Why, do you suppose, the "sturdiest," that is, the oldest, will go to the lime-trees, while the younger are "assigned" to the white clover? Try to think and then look for the answer in the "Hide and Seek in the Open" section at the end of this chapter. Also see if you can think *how it was found* that bees that go into the fields in the morning do "home work" in the afternoon, such as heating and fanning the brood-cells, or making wax; and that bees that have been gathering pollen all one day, spend the next searching only for nectar. (The most valuable knowledge is that which tells you how to find out things for yourself, and gets you in the habit of doing it; and that is the particular value to young people of the study of science in the modern school way, by personal experiment and investigation.)

That bees should know a good deal about botany is not surprising, perhaps, but listen to this from the work of a French authority:

Bees seem to be perfectly informed as to the locality, relative honey value, and distance of every nectar-bearing plant within a certain distance of the hive, and work first on those that give the largest returns. In the spring, for example, after the willows have bloomed, when the fields are still bare and the first flowers of the woods are their only resource, they visit the violets, lungworts, and anemones. Later, when other flowers are in bloom, they forsake the flowers of the woods and confine their visits to the more profitable flowers of the fields and garden.

As further evidence that all this "formation of a more perfect union" and of "providing for the common defense"

against the cold and cruel winter, grew out of the first step at being sociable, the science people point to the case of a certain European species of carpenter-bee. While they each shift for themselves during the summer, as all carpenter-bees do, yet when the chilly autumn winds remind them that it's bedtime for all the Little People of the Six-Legged World, they snuggle together on a stock of asphodel and spend the winter there.

I don't want you to make too much of such things, you understand; to suppose that really and truly these little creatures *thought things out* and worked things out as human beings do, but they are very interesting things to hold in mind until we know more. Don't you think so? How can we afford to turn our backs on such facts as I have been telling you about: this step-by-step growth of the work-together idea? Take this matter of spending the winter together. While among the carpenter-bees only certain species do it, among other wild bees that keep house all by themselves in the summer, wintering together is a regular thing.

THE IDLE RICH OF THE BEE REPUBLICS

Yet, just as it is in human history, the bees, while advancing in most respects, have lost out in others. For one thing, they also have developed a class which we may call "the idle rich." I needn't mention any names—you know I mean the drones. Among certain wild bees of the tropics, on the other hand, who live a national life as complete as that of our hives, the males work. They make wax. In our highly civilized hives, however, while the *workers* are perfect models of industry, the drones are almost perfect

examples of laziness. They help a little in running the fans, making the jelly "jell," and getting the babies a drink, as we shall see in a later chapter — but nothing to speak of.

Then, of course, there is that overdoing of the swarming business. And they are apt to store a lot more pollen than they need. This not only wastes time and wastes labor, but some of this pollen is bound to get rancid — you've tasted it in honey — and it musses up the combs.

But to offset the fact that, like some other people, they don't always show as good judgment as they ought, bees have developed one of the most important features of human civilization, namely, language. Although it is not generally known, any bee-keeper will tell you that bees can express themselves to a remarkable degree.

If you tap the hive in winter, for example, and they reply "H-u-u-mm," it means, "We have our queen and plenty of food." But if the reply is a loud "Dzi dzi," it means, "Our store of honey is running low." A loud "Dziiii" means, "We're cold!"

II. THE POLICE SYSTEM IN THE BEE REPUBLICS

Another thing — I hate to tell this, but it's true — *all bees are not all that a bee should be.*

Did you ever visit a bee community? If so, you may have noticed certain bees pacing up and down before the city gate, the little hole in the front of the hive. Perhaps, as you approached, one of these bees took flight with an angry buzz. That was a bee's way of saying:

"Move on!"

And if you didn't move pretty quickly and with your hat pulled over your eyes, perhaps you got into trouble with the police. These sturdy citizens, making their regular beats up and down in front of the city gate, were part of the bee city police force. You didn't know, maybe, what they were there for, but *they* knew what they were there for! They were there to keep out burglars. Every time a bee from the outside comes to this city gate, one of the police — whichever happens to see him first — challenges him.

"Halt! Who goes there?"

"A friend."

"Advance, friend, and give the countersign."

The new arrival and the police touch antennæ if the incoming bee really belongs in that hive. The antennæ, among other things, serve as a means of conversation in the insect world; and both the bees and the ants are highly advanced in the use of this antennæ language.

But certain hard characters of the community — burglars, that's what they are — don't know this countersign; that is to say, coming from another hive to the one they intend to rob, they have the odor of this hive, which the police can readily distinguish from the odor of their own hive by the sense of smell in their antennæ. So Mr. Burglar¹ watches his opportunity to slip in when the guards have their backs turned. Inside the hive, near the gate, there are guards, also, but the burglar runs much less risk from them, so it seems, provided he can get safely inside.

¹ Of course it's really "Miss Burglar," but I don't like to speak of a burglar as "Miss." It's bad enough to have to speak of this thing at all.

And, provided he doesn't lose his nerve. The bees inside, says one of the best-known bee-keepers in the country, Mr. Root, of Medina, Ohio, seem to take it for granted, when they see him among the other citizens, that he is one of them; but if, as soon as he gets inside the gates, he goes straight to the honey-jars and begins eating, they suspect him.

BRAZEN WAYS OF A BURGLAR BEE

So if he's had experience at this business — as many have, I'm sorry to say — he loiters about before he goes to the pantry. But here again there's danger. If he takes too long at his meal it looks suspicious, because workers in the hive don't need to do that; they take a sup now and then and go right on with their work, while bees coming in from the field have had plenty of opportunity to get nectar among the flowers. So some suspicious citizen is liable to come up behind the stranger when his head is buried in a honey-cell, like that of a cat in a cream-jug, and, after examining him by the antennæ test, pounce on him and sting him.

When a burglar is approached after entering, if he's an old hand, he will stand his ground and allow himself to be examined with wonderful indifference; but if this is a first offense he shows a certain uneasiness and a disposition to move slowly toward the gate. Then the citizen whose suspicions have been aroused, begins to use force perhaps; bites him, and, with its mandibles, seizes him by the wings to hold him until others come to help. Sometimes, even then, the robber braves it out; at others, he breaks away, and by an adroit series of twists, turns, and tumbles,

escapes; even when three or four bees have hold of him at once. Some professional burglars, after getting out safely, will wheel around and come back and buzz away right under the noses of the police!

Regular little daredevils! Brazen outlaws among respectable citizens!

Indeed, once launched on a criminal career, they often seem to lose all moral character, and to delight not only in burglarizing but in insulting the bee-keeper and his visitors; buzzing about one's face until it makes one cross-eyed to keep watch of them, for the eyes are the favorite points of attack.

IT'S NO JOKE, THIS BURGLAR BUSINESS!

One of the important features of the business of bee-keeping is to look out for these robbers; for, if they aren't caught and disposed of in time, the robbing mania will spread so that whole republics will go to the bad, the inmates of robber hives rushing into an honest community, knocking over the guards and robbing it of its last drop of honey! Sometimes, as in case of the savage hordes that have overrun civilized nations in human history, these outbreaks are due to poverty. During a dearth of nectar in the fields, there are always some bees smelling around other people's hives, and it is best for small colonies to have narrow gates where only two or three bees can pass at a time. Then this narrow entrance, like the pass at Thermopylæ or the bridge that Horatius kept in the brave days of old, becomes a pass that can be easily defended by a few determined spirits against hordes of invaders.

And, by the way, the Romans among the bee people

still show the valor of their ancestors. Even a small band of Italian bees will hold the treasures of their hives against any number of the enemy. Mr. Root says he has seen the wounded and slain piled up at the city gates by hundreds and by thousands before the invaders would give up trying to force their way in, but at last they are compelled to retreat.

III. THE MARTHA WASHINGTONS OF THE ANT REPUBLICS

As *George* Washington was the *father* for his country, the *Martha* Washingtons of the United States of Insectdom — these Marthas that are busy about so many things — are the *mothers* of theirs. And, as you know, there are two sets of Marthas in the insect republics. One set — the queens, as they are called — are the mothers of the *children* of the country, while the other set, the workers, are the *mothers of the country itself*, as you may say; that is, they are the mothers of the country in the sense that George Washington was the father of his. As you also know, these insect mothers of their country are what are called “neuters,” the word “neuter” being used in somewhat the same sense that you use the word “neuter” in grammar. The workers, however, are not, strictly speaking, “neuters.” They are undeveloped females who can have no children of their own, but they take upon themselves all the cares of the household, including the rearing of the children of the queen. Among the ants they are like devoted aunts to the little ones, feeding them, bathing them, carrying them about and, of course, petting them and raising them up in the ways that little ants should go. Not only that, but



Courtesy of the American Museum of Natural History

INTERIOR OF AN ANT NEST

they run the government; and there are stateswomen among them who, in times of national crisis, take charge and lead the way.

Let me just give you an example of their statesmanship.

The nests of the ants are often in places exposed to great and sudden changes of temperature and moisture. Time and again a chill wind in spring or a sudden deluge of rain in summer makes it necessary for these housekeepers to gather up their charges and hurry them into warmer or drier rooms in the family mansion.

Well, after this sort of thing has happened several times, it becomes plain that it would be wise to move into some entirely new region; to migrate, as the Pilgrim Fathers did.

THE LEADING SPIRITS AMONG THE ANTS

But the thought doesn't take hold of the whole community at once. You know how it is with a lot of boys and girls at a party or on the playground or on a hike. Some seem always to have plenty of ideas about what to do next and others haven't; and those who haven't usually follow the ideas of those who have — sooner or later. It's like that with the ants. The notion of moving, for instance, comes first to a few of the leading spirits. The fact that certain ants take the lead may be because they are more sensitive than the rank and file to coming changes in the weather — "feel it in their bones," as we say of human beings. At any rate, that's what the men of science who specialize on ants, think about it. But whatever the reasons, the fact is that these leading citizens, after deciding on a new town site for the community, induce all they can to go with them by telling them what a nice place it is. Those who won't be persuaded they pick up bodily and carry from the old home to the new!

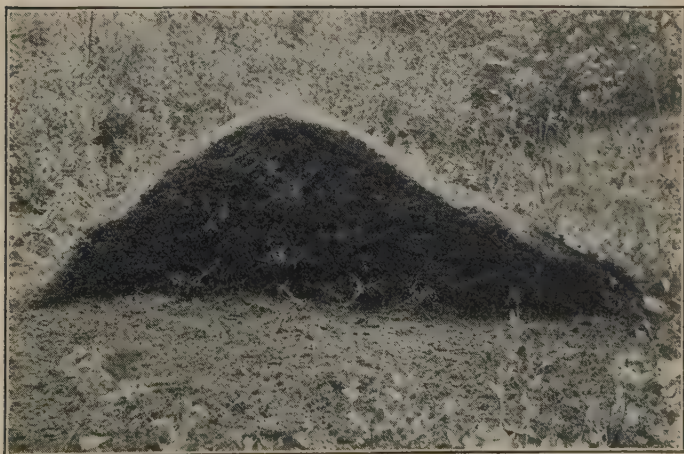
Now an ant, little as she looks it, is like a cat in several ways. For one thing, she washes her face with her "paws";

for another (as we shall see in the story of the summer boarders in Chapter X), she likes to be stroked; and for another, it's hard to get her away from old home places.

So the leading citizens have no sooner carried these stay-at-homes to the new dwelling in the "far countree" than, lo and behold, back they come bag and baggage — eggs and babies and all!

This sort of thing may go on for days — for weeks even. But the leaders, with the patience and foresight of statesmen — stateswomen, of course — persist. As a result of this patience and persistence "more and more keep joining the radicals," as Doctor Wheeler puts it. Then finally, everybody — men, women, and children — are settled and happy in the new colony.

The Daughters of the Revolution have won the day!



Courtesy of the American Museum of Natural History

SECTION OF HOME OF MOUND-BUILDING ANTS NEAR
WESTFIELD, N. J.

HIDE AND SEEK IN THE OPEN

(STRANGE AND CURIOUS THINGS TO BE SEEN IN THE LAND OF THE SIX-LEGGED IN FEBRUARY. SEE INDEX ALSO UNDER "MONTH BY MONTH")

In all of which — in all the management of the affairs of her wonderful little nation — Her Royal Highness, the Ant Queen, says never a word!

In the ant and bee republics the nominal head of the nation, the queen, not only has no veto, as human kings and queens sometimes have, and as our President has, but she isn't even allowed to vote. Her people think all the world of her, but they also think they know best about the management of public affairs. And, no doubt, they do; for the queen has a much smaller brain than the workers, as you can see, and it's brains that count in life's affairs.

The only time an ant queen, for example, is really queen is when she starts to found a colony — before she has any children to tell her what she may or may not do. At this period of her life she acts just as she pleases, does all the housework, and fairly wears her teeth out with the digging of the nurseries for the coming babies. But after she can afford to keep housemaids, that is to say, after her daughters are born, they take over all the housework, and all mother has to do is to eat and sleep and stroll around the nest, and drop a couple of thousand eggs or so, which the maids pick up and care for.

These daughters do everything for her except let her have her own way, as she shows she wants to do occasionally; when she takes a notion to travel into foreign parts, for example, into the great world beyond the ant home. In fact, if I were in her place I'm afraid I'd get a little annoyed at times.

"Oh, dear! I wish you children would let me alone *once* in a while! It's 'Mother, don't do this' and 'Mother mustn't do that' all day long."

I can almost hear her say it, can't you? But the commandment in Ant Land seems to be "Parents, obey your children," and the mother queen always finally submits.

You wouldn't care to be a queen under such conditions, would you? But among the bees it is even worse than it is among the ants. Do you know that in Honey-Bee Land you can't even get *born* without a permit? If you're a princess, I mean. Yet we

must admit this is for the best, under the circumstances; for the royalties of the hive, like our human royalties in the old days that history tells about, have a disagreeable habit of killing each other so as to avoid discussion as to the succession to the throne.

To prevent such savage disputes, the workers put time-locks on the royal birth chambers, so that only one princess can come out at a time, and in due order, after each successive princess has left the hive with a swarm of her own or been otherwise disposed of.

And how do you suppose they make this "time-lock"? Like most of the wonderful devices of nature, it is extremely simple. See if you can't think it out while I tell you about the building of the royal birth chambers themselves. In fact, in the very act of telling you this, I'll be almost telling you the answer as to how the time-lock works, which you will find in this department in May, when social and business life is at its height in Honey-Bee Land. Now listen:

When the egg-laying powers of the queen begin to fail, usually when she is about two or three years old — the workers make several special cells in which they raise princesses, who in their turn are to be queens. These royal cells are large thimble-shaped affairs. You can easily tell them. They stick out away beyond the other cells and the caps are made very thick, which is one reason why they stick out so. Now, remember that young bees in their cells get born by cutting off these caps with their mandibles, and the help of the mandibles of their sisters on the outside who have come to the birthday party; then, knowing this much, put on your cap — your thinking-cap.

In the matter of heirs to the throne killing one another, the ants have gone farther in civilization than the honey-bees. In Ant Land, as among civilized peoples, these royal practices have gone out of fashion. There are usually many young queens at large in an ant nest before they go away to form colonies of their own, and they are courteous and kindly to one another and act as perfect ladies should — go out and romp together and all that. Doctor McCook saw them do this and you can see them do it, if you watch carefully in the ant social season—along in May, say.

Ants are also very teachable. In a few days one well-known observer, Weissman, taught a brown ant to come to his finger for food, although at first it would run away as fast as its six legs could carry it.

Sir John Lubbock taught an ant to "take the elevator." In the type of ant nest which he used and which you can easily make, the ants, like Robinson Crusoe, lived on an island, and this island was surrounded by a "moat" — a little ditch with water in it to prevent the ants from escaping into the room. Between the island and the "mainland" there was a kind of "drawbridge" (speaking in terms of the days of knighthood) on which the ants could pass to and fro when Sir John wanted them to. This bridge he shoved under one of the ants and transferred it to the island several times. Then, whether on the island or the mainland, as soon as the "elevator" was put before it, the ant mounted and rested quietly until carried to its destination. Then it dismounted. Other ants, not thus trained, would attack this little passenger-car when presented to them, or else run away.

Ants have a "first-aid" system, too. In Sir John's nest workers repeatedly fell into the water, and others pulled them out; although in the ordinary lives of ants this kind of thing wouldn't happen once in a thousand times, as they don't have any moats around their castles or build on the edge of water. Those who are not willing to credit ants with intelligence say this rescuing of their comrades was merely "reflex" action, like pulling one's finger away from something hot, without stopping to reason about it. But whether it was "reflex" or not, I say it was a mighty fine thing to do, don't you? And remember what Doctor Wheeler says about the agricultural ants of Texas, carrying weary workers home from the field.

During the winter months larvæ of many species of gall-makers may be found in the galls of willow and other plants. Wouldn't it be interesting to find one of those oak galls in which the ant sentries, in the summer-time, use their queer heads for a door and make you give the pass sign before they will let you in or out? (See May chapter.)

On the ground beneath currant bushes you'll find the chrysalides of the currant worm. The more of these chrysalides you rake up the better it will be for the currants next summer — and you know how you love currant jelly!

Look for the chrysalides of *Asterias* and cabbage butterflies attached to fences and outbuildings and those of the Viceroy on willow and poplar twigs.



Copyrighted by Harper & Bros.

JACK TAKES HIS NIGHTCAP OFF!

(See page 85.)

CHAPTER VII

(MARCH)

THE GREAT AWAKENING

“Well, good-morning, Mrs. Bumble! Are you up for all the year?”

“Hum! Hum!” says Mrs. Bumble, burying her nose in a neighboring willow blossom.

It was a Miss Hive-Bee, on her first spring journey for pollen, who asked the question — and just for a little joke, I suppose. The hive-bees get up for all the year as soon as the earliest willows are in blossom in March, but Mrs. Bumble merely comes out for an early breakfast and then goes back and sleeps until April or thereabouts. Then she also gets up for good, and after that, as with other mothers and the older sisters in the family life of The Land of the Six-Legged, it's one continual round of preparing for birth-

days and birthday parties, feeding the babies and getting them a drink, building nurseries and providing fresh air and all the rest of it.

So I thought this little conversation between the two early risers, that I happened to overhear, would be a good beginning for this chapter, which, as appropriate to the great awakening of nature in the spring, is mostly about birthdays and birthday parties. And as I haven't time to attend them all — much as I'd like to — I'm only going with you to the parties of the bees and the butterflies, and then tell you at the end of the chapter ("Hide and Seek in the Open") about some of the things the wasps and others will do at *their* parties, and you can look in for yourselves.

I. BIRTHDAYS AND BIRTHDAY PARTIES AMONG THE BEES

Let's begin then with the bees, and, first of all, with the Bumble family. The first thing Mrs. Bumble does to get ready for the birthday party in her house is to make a birthday cake. And this bumblebee cake is sweet — you ask any little bumble if it isn't — and it's made with flour, and mother stirs it, much as your mother does when she makes a cake! Mrs. Bumble hasn't any sugar, to be sure, but she uses honey, just as the ancient Greeks did in making the cookies which helped to make Athens famous.

HOW MOTHER BUMBLE MAKES HER BIRTHDAY CAKE

If you'll go down where the willows are in bloom in late March or early April you'll hear a sound like that of a fairy pipe-organ. This sound is the combined hum of the Mother Bumbles who are there in crowds getting flour and

honey to make their birthday cakes. The flour is the pollen of the blossoms, which they stuff into the market baskets on each hip. The nectar they suck into their crops will change to honey by the time they get back home.

Arrived at her family residence, Mrs. Bumble mixes the honey with the flour, and then kneads it with her jaws into a dough which she builds into a solid mass. On this she makes a ring-like wall of wax, the first cell. In this she lays about a dozen eggs.

It is out of these eggs that the little people come to the first birthday party and begin eating into the big cake on which they are born. Then later, when the mother can get help with the housework — there's not a maid to be had early in the season — she lays more eggs, and there are more birthday parties, and so on through the year.

THE RAINY-DAY HONEY-POT

But I forgot to say that before she lays her eggs, Mother Bumble makes a honey-pot of wax about half an inch across and three-quarters of an inch deep, fills it with honey and puts it close to the door of her setting-room — that is to say, she builds it at the spot where she wants it.

No, that wasn't a mistake — I meant "setting"-room and not "sitting"-room, for the bumblebees brood their eggs just as the earwigs do and as mother birds do.

One curious thing about this honey-pot is that after the mother goes to setting, it will grow shorter and shorter for a while, and then taller and taller. That very thing happened to Alice in Wonderland — the time she had to get through a keyhole, wasn't it? How many things we run across in these adventures in nature's wonderlands that are

just as strange as anything in the story-books! And one delightful thing about it is that you can actually *see* these real things, while in the story-books you can only *read* about them.

But what do you suppose makes the honey-pot do that? It's simple enough when you know. The purpose of the pot is to keep honey on hand for rainy days. Mother Bumble sits on her eggs with her face to the door, where she can reach into the honey-pot with her long tongue, and yet the pot is far enough away from the door so that she can get in and out. On rainy days and when the weather is raw, as it is quite apt to be in the early spring, she doesn't go out for her meals, but dips into the honey-pot. As the honey gets low in the pot she bites down the walls so that her tongue can reach it. Then she builds it up and goes out and gets more nectar and fills it up again.

WHEN MOTHER BUMBLE'S HOUSEMAIDS COME

After about a month the pot will stop growing taller or shorter or holding honey, and will fall to pieces. That's because by that time Mother Bumble will have a lot of maids about the place to help and to bring her food on bad days, and she won't need it. These maids are her own daughters transformed, by way of the chrysalis stage, from the earliest laid eggs, and although, unlike the queen mothers among the hive-bees, Mrs. Bumble still takes part with her daughters in all the housework, she leaves most of it to them and devotes her time to laying eggs and hatching out baby bumbles.

After hatching, the little worm creatures are fed with bread and honey (*i. e.*, a mixture of pollen and honey) by

the adults among their younger sisters. These little nurse sisters collect the honey and pollen themselves and mix it for the babies. Meanwhile other workers cut little openings in the cells — open the bedroom door, as it were, and the nurses do the feeding by passing this prepared baby food from their own mouths into those of their baby sisters.

When the worm babies so fed have reached full growth — that is to say, on the twenty-second or twenty-third day after the eggs are laid — they spin little silk cocoons, transform to the pupal stage, and after two or three weeks change again — put their wings on and come out perfect bees. Little Miss B-with-her-new-wings-on opens the door of her birth chamber by gnawing a hole through the waxen cap. As soon as she is out of it, the other workers gnaw off the upper half of the cell, clear away the cocoon, the egg-shell, and other rubbish, so that the cell will be nice and clean, and then use it for storing honey.

Before the first-born bees are grown up enough to be of any help, Mother Bumble certainly has her hands full, what with laying eggs and brooding them, clearing away the wax she had previously piled over the cells to help keep the little grubs warm; helping the babies to get born by gnawing off the cell-caps; making new cells and laying eggs in them — and with babies hatching at intervals of only two or three days between. How she manages it all without a single maid about the place is beyond me!

Cells for the second and later broods are built on the sides of the taller cocoons, so that the eggs in them can also be warmed by the mother's body as she sits on the first brood. This is what gives a bumblebee nest that hig-

gledy-piggledy appearance at the end of the season. But you see Mrs. Bumble knows what she's about.

You've known about bumblebees ever since you can remember, no doubt, but isn't a good deal of this that I've been telling new to you? And isn't it interesting?

MRS. CARPENTER-BEE AND THE SWEETMEAT IN HER COOKIES

Now let's see what we can learn about some other wild bees. Take the carpenter-bee, for example. You've seen her digging her nest in the woodwork outside the house. This mother bee makes cake for her babies, too, and after Mrs. Bumble's recipe, by disgorging a little honey into a tiny batch of pollen flour. Then she lays an egg, with the fore end free and the other end lightly fixed in the cake. This bee baby has to get born all by itself, as its sisters in adjoining rooms can't help it and its mother never sees it. So when it comes out it has the honey-pot, like a sweetmeat in the middle of a cookie, right under its mouth. This honey is more easily digested than the rest of the cake, and, as the baby grows stronger, it releases its tail and eats the remainder. In a species of these carpenter-bees where the food is all honey, the egg is laid at full length, for then the baby can safely eat at random.

WHERE THE YOUNGEST MAY BE THE FIRST-BORN

If they have any disputes in the world of bramble bees over the inheritance of property, as so often happens among human beings — particularly in novels — it must rack the brains of the shrewdest bee lawyers, it seems to me, to tell who the true heir or heiress really is; for often, with these little people, it is the youngest that is the first-born.

The rooms, each with its egg, are built one above another in that hollowed-out bramble, so that the last egg laid is nearest the only door; that is to say, the top of the stem. As a result it is the youngest of the family, the one that hatches from the last-laid egg, that usually comes into the world first. Then, the room above being empty so that he can have a clear passage, out comes the next youngest, and so on down to the oldest, the egg first laid at the bottom.

HERE'S FAMILY MANNERS FOR YOU!

But while they usually *come out* in the order named, there is no regular order in their hatching. The eggs are all laid at intervals of only a few days, and the first to hatch may be in any of the chambers. Now observe the curious thing that happens, the fine courtesy these little brothers and sisters show toward one another. The first to hatch, wherever it may be, gnaws a little hole in the plastered ceiling that separates it from the room above. Then it puts its head through the hole, and, if it finds the next room still occupied, draws back politely and waits a couple of days; three days if necessary, Fabre says. Then it tries to slip between the wall and the body of its little sleeping neighbor. Sometimes it will gnaw away part of the wall to make a wider passage. Finally it gets through. Then comes a second partition, perhaps, and beyond that still others. It will never touch its brothers and sisters, although gnawing the wall fiercely in its eagerness to get into the big world of flowers and sunshine outside its dark and narrow birthplace.

"When two neighbors awake at the same time," says the

great French poet of the insects, "mutual visits are paid through the aperture between the rooms." May this not be to cheer and encourage one another to be patient?

HOW THE LITTLE BRAMBLERS OBEY THE LAW

So you see how these little bramblers obey the great law of the Golden Rule, of doing as you would be done by. Now notice how Fabre found that, when it is required, they obey another great law, a physical law. In my story of "The Adventures of a Grain of Dust," I spoke of the mysterious power called "gravity" being as careful about handling a grain of dust or a flying seed as in keeping the worlds in their orbits. Now here is another example of the same sort of thing. Fabre put some bramble-bee cocoons in glass tubes, so that he could observe the action of the bees when they hatched. He alternated these cocoons as to the direction of their heads, some being turned one way and some another. Those having their heads up attacked the partition above them; those with their heads down — most of them — did the same by first turning around.¹ But some near the bottom opening went out that way. That set Fabre thinking on another tack. Notice what he did and you'll see what he was thinking about. In a tube he put ten cocoons. Of these, five on the left went out through the left opening, five on the right went out the opposite doorway, reversing when necessary the direction of their heads in the cell.

Now there is only one chance in a hundred that bees — or anybody else, for that matter — would do such a thing

¹ How did they know, shut in the dark there, which way was "up" and which way was "down"?

by *accident*. One chance in a hundred, did I say? One chance in 512, to be exact. Mathematical calculation shows that, out of 512 ways by which they might have gone out, they chose just the right one; the one that required the least expenditure of energy on the part of everybody concerned. Bees of another species, under the same conditions, followed each other like a flock of sheep. When Fabre closed one end of the tube, both kinds of bees all went out at the opposite end, as if they knew the other door was shut. And yet how did they know? Fabre concluded that the action of the bees was due to some influence of the air felt through the open end or ends.

BIRTHDAY DANCES IN THE HIVE

Among these solitary bees who never see their mothers and who have no older sisters to pet them, there are, of course, no real birthday parties, but among the hive-bees — and, no doubt, to some extent at least, among the bumbles — there are real rejoicings and festivities. This is certainly true of the hive-bees. “If,” says a veteran bee-keeper,¹ “a colony is without young bees for a while, there is new life and energy throughout the hive as soon as they begin gnawing out.”

And listen to Maeterlinck:

Over the entire area hundreds of workers are dancing and flapping their wings. They appear thus to generate heat that aids in the hatching, but the dance contains some extraordinary movements that nobody has yet explained.

In a few days the lids of the urns — 60,000 to 80,000 in a good-

¹ Mr. Root, of Medina, Ohio.

sized hive — will break and two large, earnest black eyes will appear, surmounted by antennæ that are already groping toward life. A nurse at once comes running, helps the young bee to emerge, cleans and brushes her. At first the new-born is bewildered, trembling and pale. But presently, when she has grown strong enough, she makes her way to the cells that are closed and begins to beat her wings and dance in cadence, so that she in turn may quicken her sleeping sisters.¹

You can see all this in your little observation hive at home or in school. You will also see that, before hatching, the larvæ have rudimentary legs which disappear. These legs are supposed to have been inherited from some ancient type of bee among the "first families," in which the larvæ had feet and crawled about for a while, as caterpillars do before changing to their final form.

Toward the end of its worm life the three segments or sections next to the head show little scales beneath the skin on the under side. These are the beginnings of the real legs. But you can't see this until you put the worm in alcohol. In this way you can also see its budding wings on the second and third segments; also, in the queen and workers, you can see the rudiments of the stings.

A BEE'S THREE BIRTHDAYS AND THE PRESENTS

When the older bee comes running to welcome her sister into the busy, happy world of the hive, she drops some honey into the baby's open mouth, its third birthday present; for bees, like other Little People of the Insect World, have more than one birthday, and each time they get

¹ "The Life of the Bee."

presents of something good to eat. The first birthday is when the bee comes into the world as an egg. To see a bee egg you will have to look sharp. It is not much larger than this period (•). Under the microscope you will see that it is covered with a kind of network. Just before hatching, the egg itself is fed with a milky fluid which goes through this network and helps give the little creature in side the strength to hatch into a tiny white worm.

After it becomes a worm it is still fed with milk. This milk, I may add, is carried in a special "milk bottle," a gland in the nurse-sister's head. Then, after feeding for about six days on a luncheon of bread and honey, put into its cell by sister nurse to last until it can get to dreamland, its cell is sealed up with a paper-like cover through which it can breathe, and so it spins its cocoon and goes to sleep. Twelve to fourteen days later it gnaws off this cap and comes out a perfect bee.

During very warm weather sometimes the little sleeper is allowed to "go bareheaded," as Mr. Root expresses it. That is to say, no cap is put over the cell.

THE WEANING OF THE BABIES!

The larvæ of both the workers and the princesses — future queens — are fed at first on this very rich milk, but after a few days the worker larvæ are put on a coarser diet of honey and pollen, while the princesses get a "special brand" of this milk. It tastes like a mixture of rich cream, honey, and quince jelly.

The workers live only six or eight weeks, the queens two to three years.

BUT TALK ABOUT GROWING CHILDREN

Six to eight weeks don't sound like much of a life. But remember what we learned in our sleepy-time stories last winter, namely, that bees never sleep; so they put in two days in one, you may say. They do everything fast — their growing, for instance. The bee larva more than doubles in size in half a day; in twelve days is full-grown, as a larva, and about two weeks later begins its busy life as a bee.

GETTING THE BEE BABIES A DRINK

But before we leave this part of the story, there's one more thing I must tell you, and that is how the bee babies get a drink. You know how it is with certain other little people after they have gone to bed and can't think of any other excuse for not going to sleep.

"Please, mother, I want a drink!"

Haven't you heard your own baby brothers and sisters say it? Well, I don't know whether baby bees say that, but there are times when somebody has just got to go and get them a drink! Ordinarily the condensation of the warm air in the hives on the cooler walls gives the necessary moisture, but sometimes there is not enough, and then the workers go out and drink dew from leaves and bring it in their honey-sacks to the thirsty babies.

II. BIRTHDAY PARTIES IN BUTTERFLY LAND

Among the butterflies, as among the solitary bees and solitary insects of all sorts, as a rule the babies have to get

their own food and drink, because there are no mothers or older sisters there to wait on them.

Take the life history of the magnificent Monarch Butterfly as an example. The caterpillar, after hatching, eats the shell of its egg. But first of all it takes a little walk, a kind of before-breakfast constitutional, and noses around among the leaves. Then it has a few bites of the shell, then comes another stroll that may last ten minutes. By this time it has worked up one of those appetites for which all caterpillars are famous, and eats voraciously for five minutes or so; then more wandering, followed by a still larger meal of egg-shell. Then it begins on the green things.

You will find the Monarch's eggs at the centre of the under side of milkweed leaves. If you see a Monarch resting a moment on a milkweed leaf, apparently not doing anything in particular, it is probably laying these eggs. Watch closely and you will see that, while clinging to the edge, its body is slowly curved upward and the end of it pressed for a moment against the lower side of the leaf. Then a slight shift and another pause. At each pause it is laying an egg.

These eggs are cylinders with a little cone-like top the color of pearl. Take one of these leaves home, and on the morning of the third day after the eggs were laid the cones will turn a dark purple, and later two bright bubble-like spots will appear in them, and keep shifting from one point to another.

THE MONARCH'S BIRTHDAY DANCE

Then, all of a sudden, the egg will begin to shake about, due to the wiggling of the caterpillar within. Next a hole

will be eaten through the side, and out will come a tiny black head, and at last the tiny caterpillar itself.

Before finally undergoing the wonderful change into a butterfly, the caterpillar changes its clothes, that is to say, moults, four times. Although its skin is thin, this skin is of a horny substance and won't stretch. As the caterpillar grows the old suit gets too tight, and it must have a new one from time to time. When ready to moult, it remains in one position for about twenty-four hours, as if it were dead. It attaches itself to a little silk pad, and gets out of the old suit very much as when it changes to the chrysalis form, as described in Chapter IV, except that after each moult it eats up its skin. After splitting the skin back of the head, the rest of the process takes about five minutes. Then, after waiting for about an hour for the new skin to harden, it is ready to eat again.

Some three or four days after the fourth moult and a series of very hearty meals, it becomes very restless. It wanders up and down the plant, and finally leaves it, and, under shelter somewhere, puts on its wings and becomes a butterfly. You will notice that it walks back and forth and back and forth until it seems exhausted, and then hides and becomes perfectly quiet. Much as a tired child sinks to sleep, the caterpillar sinks into its sleep of the beautiful dream that comes true; the dream that when it wakes up it will be a butterfly and sail the air on its glorious wings.

MYSTERIOUS CHANGES THERE IN THE DARK

During the mysterious sleep the parts inside the skin melt away, while the skin itself is moulted and the chrysalis comes through. Out of the melted-up material within,

new limbs and organs begin to grow. The powerful biting jaws with which the caterpillar ate leaves are replaced by the long proboscis with which the butterfly sips nectar. While it was a caterpillar it had ganglia — those little brain-like nerve-centres in the different segments of its body — for the operation of its legs and its general movements in getting about. Fewer and smaller ganglia now appear in the segments toward the rear, because the four extra legs it used to have in that region as a caterpillar will not be wanted when it becomes a butterfly; so they disappear and with them the “brains” that governed them.

I can't say that the actual brain matter so saved is worked up into bigger brains elsewhere, but I do know that, at the very time when these little and old brains are growing fewer and smaller, new and larger brains are coming into being in that mysterious “dark room,” the chrysalis. One set of these new brains is in the head and will govern the new compound eyes of the butterfly, that take the place of the simpler eyes of the caterpillar and enable it to see the brilliant beauty of the flowers that the butterflies delight in. Another set of the new nerve-centres will govern the wings with which it sails so gaily over the flowery fields and dances in the winds.

The chrysalis itself is a living thing. It breathes and its blood circulates. Just before the butterfly comes out the chrysalis grows soft to the touch, and if you press one end of it gently the other end will wiggle. Usually about twenty-four hours before its birth you can see the color and markings of the butterfly through the thin skin of the chrysalis.

A week — or it may be ten days — after the caterpillar

of the Monarch Butterfly passes into the chrysalis stage, it begins to grow dark along the lines where the antennæ, the "feelers" are to be. And so with the legs and tongue of the future butterfly. This dark coloring gradually spreads over the head and wing regions. Next appear the characteristic black veins of the wings of the Monarch, with the brown and white spots in between.

THE BIRTH OF THE BUTTERFLY

When the time arrives for the butterfly to be born, the stout chrysalis in which the caterpillar wrapped himself like a mummified Pharaoh in his case begins to open; a doorway into life! A rent appears along the lines between the antennæ and the wings, and the part of the chrysalis which covered the legs, the antennæ, the tongue, and the eyes moves slowly outward.

The mysterious stranger is eager to make its exit from the dark chamber and into the sunshine and the joyous life of Butterflyland. Its movements become very rapid. The head is withdrawn from its covering, and first one antenna and then the other is freed. The feet struggle out from their cases and take hold on the outside of the chrysalis. The wings are also set free, but they are at first small and soft. Last of all, the long abdomen — about all that is left to remind us of the caterpillar — is pulled out of the case, and the butterfly is born!

HOW THE BUTTERFLY "PUTS ON" ITS WINGS

But wait! Although a butterfly, it cannot fly. It must first get those soft wings ready for flight. They must be

unfolded, dried out, and made stronger. On first coming out, the young Monarch crawls over to its empty chrysalis and up on some supporting plant, where it hangs wet with



Courtesy of Ginn and Company

EMERGENCE OF BUTTERFLY



PROMETHEA JUST OUT OF
COCOON

the acid stuff which it uses in melting away its chrysalis and so helping itself to get out.

When it first emerges, its body is large and heavy, but now notice what a strange thing happens. Remember what I said about using the material in little brains to make bigger ones—a thing that comes about in some mysterious way there in the dark room, the chrysalis? Well, here's a similar thing taking place under our very eyes! Those little wet, drooping wings begin to move slowly back and forth, as much as to say:

“Oh, please, Fairy Godmother of the Butterflies, I want

to fly! Like this! And I must have bigger wings or I can't! So won't you give them to me?"

You know, if we want a thing badly enough — something that is good for us to have — and we try hard enough to get it, do our part — we'll get it. And that happens in Butterflyland right along. For, look! Presto! While the body keeps growing smaller and smaller, with the appealing motion of those little wings, the wings themselves keep getting larger and larger until finally — there — away he goes!

What really occurs is that by this motion of the wings blood is pumped into them from the body. This makes the wings grow very fast while the body is correspondingly reduced. At the same time the exposure to the air causes the chitinous or horn-like covering of the wings and body to harden, and so give firmness to both. And the feelers no longer droop, like the Jobberwock's mustaches. They too have stiffened and are now held boldly upright.

HOW THE MONARCH PUTS HIS "NOSE" TOGETHER

But our gay little knight of the air nearly always has more or less trouble with his proboscis. This proboscis seems to be shipped from dreamland "knocked down," as a merchant might express it; that is to say, in parts to be put together on arrival. A butterfly's proboscis is made of two long grooved pieces with curved teeth along the edges — a kind of hook-and-eye arrangement I'd call it. Anyhow, just as every gentleman is supposed to know how to tie his own tie, so handsome Mr. Butterfly is evidently supposed to know how to fasten his own proboscis together. But he often has an awful time of it. And just imagine

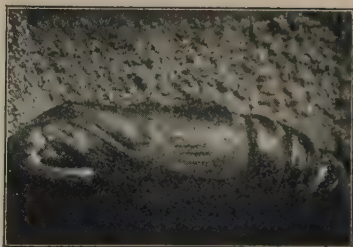
the state of mind of a butterfly of fashion like that, all dressed up in his prettiest and eager to be off to his first butterfly ball.

Before he can *think* of going he must fasten his proboscis together — for of course there are the *refreshments!* — and not only

that, but he must coil it up like a watch-spring and tuck it away. He puts the pieces together, coils and uncoils them, again and again.

“This can’t be right! Whatever *ails* the thing!”

Sometimes it is an hour before the fitting together of this long straw for drinking nectar is completed and he has the knack of uncoiling it and then packing it neatly away.



Photograph by Bash

PUPA OF SPHINX MOTH, SHOW-
ING TONGUE-CASE

HIDE AND SEEK IN THE OPEN

(STRANGE AND CURIOUS THINGS TO BE SEEN IN THE LAND OF THE
SIX-LEGGED IN MARCH. CONSULT INDEX ALSO, UNDER
“MONTH BY MONTH”)

Did you find many underground chrysalides last fall? It’s easier to find them in the spring, for then they work their way to the surface. Turn over the leaves and twigs with a forked stick. The moth family very commonly make their chrysalid beds underground or under fallen leaves. “Sphinx”-Moths, whose name comes from the sphinx-like way their caterpillars have of resting with their front sections (segments) raised and the head drawn in, pupate (change to the chrysalis form) on the ground. The moths that come from the chrysalides are called Hawk-Moths, on account of their strong flight, but some are called Humming-Bird Moths.

These "humming-birds" have the unusual habit, for moths, of flying in bright sunlight, and when hovering over flowers are easily mistaken, at a glance, for real humming-birds. The chrysalides of some of these sphinxes will be found in fallen leaves, and others underground. Some of these chrysalides you'll notice have a curved handle, as if they had half a mind to turn into little pitchers! Do you know what that handle is? It's a case in which they keep the long tongues that they will use in sipping the nectar of flowers as soon as they get born and have plumed their wings for flight. The chrysalides of the tomato worm (he's the same kind of worm that eats tobacco, and in tobacco fields is called the "tobacco worm") have these long handles, and in the South they are sometimes called "hornblowers," because this tongue case also suggests the kind of horn you blow through. The caterpillar of one of the kind of moth chrysalides you'll find in fallen leaves has a short, rough horn on its tail and feeds on the leaves of grapes and Virginia creepers. Another moth caterpillar found on grape-vines and Virginia creeper has no horn, but in its place a baleful eye-like tubercle or knob, and when disturbed thrashes around in the same sort of threatening way as that caterpillar did that frightened Cock Robin, only Polyphemus shook his head, while this caterpillar shakes his tail at you. Yes, and if you don't believe what Cock Robin and Chick Chickadee and their friends said back there in the October chapter, nor that birds ever speak of such things, just listen to this from two well-known observers:

"We have seen orioles try to pick up one of these larvæ on a woodbine (Virginia creeper) and dart away with a scream while it lifted its snakelike tail with the tubercle shining like an eye."

And this and other Sphinx-Moth caterpillars also make a squeaking noise, to surprise and disconcert their enemies, but how they make it is not known.

Boys and girls in city schools, by exchanging moth chrysalides with boys and girls in country schools or small towns where there is comparatively little smoke in the air, will learn something very interesting, namely, that moths of the very same species, when raised in the city, will become darker to match the tree trunks darkened by the city smoke; so that when they are asleep in the daytime, after their nightly rambles among the flowers, they will be less likely to be seen. You will also notice, in the case of cabbage-butterflies, that those hatched in the spring are less heavily



Copyrighted by Harper & Bros.

PUPA OF OAK-MOTH EMERGING FROM GROUND

marked than the summer form. What benefit the butterflies get out of this difference, if any, I don't know.

But what a contrast to the dress of the little white butterfly in its various styles of trimming at different seasons of the year is that of the big Mourning-Cloak Butterfly which the Mrs. B.'s — Mrs. Hive and Mrs. Bumblebee — must often meet in their early spring visits to their country place, "The Willows." The Mourning-Cloak is one of the largest of the butterflies that live through the winter. She is to be seen flitting through the leafless woods on warm March days — and resting on the willows like a leaf that has hung on through all the rough tugging of the winter winds. She has come out for her sup of nectar, too. You know her, don't

you, with the margin of the upper side of her wing trimmed in yellow, and, just inside this margin, a row of blue dots? But when she rests, with her wings erect, after the manner of butterflies, the under side is of the color of dead leaves. Owing to this disguise she is less likely to be disturbed by any early birds of the springtime, while she is providing for the future of her race by laying her eggs in masses around the twigs of the willows, poplars, and elms. On these her children — velvety, black caterpillars with orange spots — will feed and later change into yellowish-brown chrysalides with darker markings and red-tipped tubercles.

But of all the early risers in the spring among the caterpillars themselves, the tent caterpillars, the larvæ of certain dull-yellowish or reddish-brown moths, take the lead. The first eggs are laid in late June or early July — 300 or 400 of them in bands, around the twigs of wild-cherry or apple trees usually. They are carefully varnished to protect the summer eggs from rain and those laid in the fall from the winter's cold and snow. The caterpillars of the fall-laid eggs are pretty well developed before winter, but don't emerge until the following spring. Then they spin a temporary silken tent around the egg mass. If their birthplace furnishes sufficient food to satisfy their keen young appetites they may stay there, but usually they soon move to a fairly large fork of the same tree, and there spin another bigger tent. They are great family people and stay together until nearly full-grown. They rest in their tent during storms and the heat of the day, and come out when it is cool but not too cold. On their travels back and forth among the leaves for food they follow definite paths, and seem to guide themselves back to headquarters by the silken threads which they spin in their travels. They not only keep together in the tent, but move head to tail in long "Indian file" in their goings and comings. When full-grown they march away together again, but separate to find protected places in which to spin their tough, oval, white cocoons.

"Considering the fact that their webs are so conspicuous and that even the eggs can be removed in winter, it is strange," says Doctor Lutz in his "Field Book," "that they are allowed to exist."

And just see what those school-children did that we read about in the October chapter. The occupants of a single tent may eat 10,000 to 20,000 leaves. Then, spinning their cocoons in the cranies of fences and buildings, they emerge as moths in two or three weeks, and the destruction starts again.

There is another species, wrongly named "the Forest Tent Caterpillars." They are closely allied to the tent caterpillars of the orchard, but they make no tent. In France, however, there is a species of forest caterpillar which does build tents and which the great Fabre calls "the Processional Caterpillar of the Pines." He made a careful study of their habits, and his description of them in his book, "The Life of the Caterpillar," is one of the most striking things in all his works. Shall I read you some of it?

"In March they leave their silk house in the pine-trees and form in long lines, single file, each touching with its head the rear of the one in front. Each file, containing about a hundred caterpillars, toils grimly along, undulating over the dusty road in which it leaves a furrow. Then it breaks into a small number of groups, which thereafter move forward independently.

"After a couple of hours of this marching and countermarching they reach a spot where the soil is easy to burrow. The caterpillar ahead digs a little with his mandibles, explores the nature of the ground. The others make no attempts of their own. Finally some spot is recognized as propitious. The leader halts, pushes with his head, digs with his mandibles. Then the file breaks up and all begin digging with their mandibles and raking with their feet. Little by little they bury themselves. For some time the undermined soil cracks and rises and covers itself with little mole-hills. Then all is still. Two weeks later, digging, you find the chrysalides."

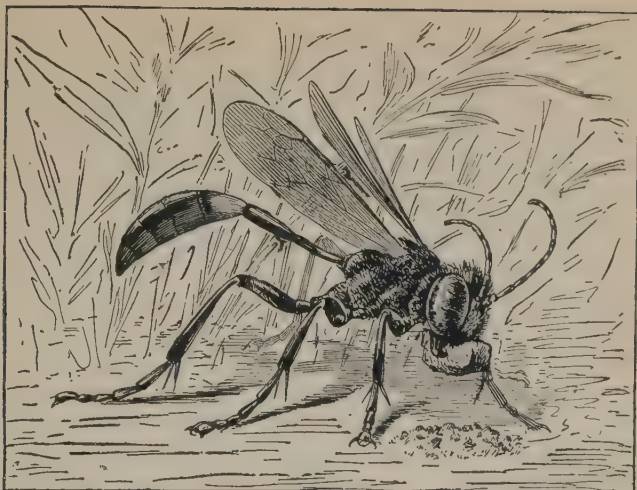
At the end of July or August they reappear, this time as butterflies. You'd almost think by the way they bury themselves — the procession and all — that they realized what was going to happen to them, wouldn't you? Perhaps insects, in many ways, are interpreting for us the deepest things in life; are living hieroglyphics with messages for us if we but read them rightly.

Did you ever notice any wrinkles in the forehead of moths whose chrysalides are found under the ground? I'll tell you why I ask. In speaking of the winged rebirth of the caterpillars of the pines Fabre says: "Pass your finger-tip over the moth's head. You will feel a few very rough wrinkles. The glass will show more and you find that they are made by a row of crescents, hard as steel. These constitute the moth's boring-tool. Observed through the glass, you see it twisting its head first one way and then another. Thus it bores its way to the surface, thrusting the dirt backward with its legs."

In late March or early April, according to climate and season, the cabbage-butterflies will emerge from their chrysalides and fly over meadow and garden. The Viceroy Caterpillars will come from their winter cases and feed on the leaves of the poplar and the willow.

Full-grown squash-bugs will come out from under the stones and other shelter where they have spent the winter and begin looking for breakfast.





WASP USING PEBBLE AS A TOOL TO BEAT DOWN THE EARTH

CHAPTER VIII

(APRIL)

SPRING HOUSE CLEANING, FURNISHING, REPAIRING AND BUILDING IN LILLIPUTLAND

Spring house cleaning, furnishing, repairing, and building starts very early among the little housekeepers of Lilliputland. What with getting born and changing into somebody else and having a houseful of children and making and furnishing a separate room for each of them, as many insect mothers do, and all in the brief span of one summer lifetime, you can't be putting things off; and you can't wait for somebody else to carry out the rubbish and sweep the floors and clean up the front yard and do your repairing and building and varnishing, and hang your wall-paper,

and beat and lay your carpets. You've simply got to attend to these things yourself, and the children have got to help. All these things are done in Lilliputland, as you will now see; and the children not only help, but they just love to!

I. HOUSEKEEPING AMONG THE BEES, ANTS, AND WASPS

In an ant-hill housework goes on, more or less, right through the winter, for with the coming of the cold season the ants retire to the galleries prepared for that purpose below the frost-line. Then, in the spring, as soon as the frost is out of the ground you see them bringing up their pellets of earth and grains of sand, dug out in the course of the spring improvements, and laying them in neat little circular mounds in the beaten paths and along the cracks between the stones of sidewalks.

They also carry out rubbish and refuse. At all times, one of their first considerations is to keep the house scrupulously clean by removing from the living quarters fragments left over from their meals — things that can't be eaten either by the ants or their numerous boarders — empty cocoons and the bodies of ants that have died. In the winter, when the ants can't get outdoors, this garbage is stored in the "attic"; that is to say, in empty upper galleries no longer used for living quarters. As soon as spring comes, however, it is taken outside and left on the "city dump." You will find little heaps of it in the vicinity of ants' nests. They remind one of the heaps of oyster shells, bones, and other kitchen refuse which mark the former residences of our ancestors of the Stone Age, and which,



Copyrighted by Harper & Bros.

CARPENTER-ANTS REMOVING PELLETS

as you know from your school readers, are called "kitchen-middens."

Things that smell bad the ants bury, covering them with pellets of earth.

'SPRING HOUSEWORK AMONG THE BEES

In the first warm days of spring, often when there is still snow on the ground, the bees begin their house clean-

ing, repairing, and varnishing, so as to have everything neat and tidy and the house comfortable for the summer work. The story is told of a bee-hunter who saw some bees going in and out of a tree in the early spring, and, supposing that he had found a supply of honey, he cut the tree down, but not a bit of honey did he find! The bees he had seen were the "girl scouts" told of in the next chapter, who had been sent ahead to choose a new home for the swarm and clean house before the swarm arrived.

Honey-bees, when they take possession of a new hive, divide up the work, so that while some are making the wax, others are cleaning house by carrying out twigs, grains of sand, bits of leaves, and other dirt and rubbish they find in the place. If there are any ants on the premises — for ants have a very sweet tooth, as you may know from their visits to the sugar-box in the pantry — the bees pick them up, fly with them to a distance from the hive, and drop them!

USE OF PNEUMATIC CLEANERS, BROOMS, AND OTHER DEVICES BY BEES AND WASPS

Last of all comes the sweeping. This the bees do by the fanning of their wings. Oh, yes, the bees have long known about pneumatic cleaners. And certain species of wasps know about them too. One of these is the wasp that makes her burrow in the roots of trees. After she gets well in with her digging she comes backing out every now and then, pushing a lot of the sawdust behind her. This she spreads with her legs and mandibles, and then blows away by the fanning of her wings, circling around just above the ground until the last grain disappears.

Another species of burrowing wasp backs out of the hole she is digging in the soil, holding her pellet of earth in her jaws, and then, flying a little distance, gives a flirt to one



WASP LEANING ON ELBOWS LOOKING OUT OF NEST
(See page 281.)

side and flings the pellet away, much as one tosses dirt from a dust-pan into the stove or the fireplace.

Still another wasp, called the "golden-digger" from the beautiful dress she wears even when doing her housework, lies down on her dirt pile and then kicks the dirt in all directions away from the front door.

Mrs. Bembex -- we'll call her that because she belongs to a species of that name -- uses a broom. She has a row

of stiff, springy hairs on the second joint of her front legs. While digging she holds her body above the ground by straightening her other four legs, and, with these brooms, sweeps the dirt back in a rapid stream.

NOW FOR THE REPAIRING AND VARNISHING

But, to return to the spring housework of the bees, as soon as the cleaning is over in the hive the repairing and varnishing begin. The repairing consists in stopping up all the cracks where rain or cold winds or dirt could come in. For this a substance called propolis is used, and with the same material the bees varnish the walls from top to bottom. "Propolis" is a Greek name given to the brownish-red, gummy stuff you find on the buds of trees such as the plum and cherry. You see, the fact that it appears with the buds makes it just right for the bees, for then they can get their houses all ready for the comb and honey making before the flowers come. This is one of the wonderful adjustments in nature that, you may be sure, didn't just "happen" that way.

Propolis is really something like varnish in the fact that it is a kind of resin; and resin, you know, is used in making varnish. The bees gather it with their mandibles and put it in their baskets, just as they gather pollen, but, because it is such sticky stuff, they have to have help in unloading, and when they get back to the hive the other bees scrape it off. The workers who do the scraping apply the propolis at once to the places where it is wanted, and they have to keep their minds on the job and be expert about it, for this substance hardens very quickly.

The bees frequently mix propolis with the wax to

strengthen the comb. In the fall a great deal of it is used to fill cracks and make everything snug and "comfy" for the winter. And when a swarm starts for a new home, each bee not only fills her honey stomach with enough honey to last five or six days for food and for wax-making, but she takes some propolis in her basket.

MRS. BUMBLE'S MADE-OVER CARPETS

So much for the spring house-cleaning and other spring housework of the hive-bees. Now I want to tell you about some other members of the bee family, and, first of all, about how Mrs. Bumble makes over and lays her carpets. When people used to cover their floors with tacked-down carpets instead of rugs — and, incidentally furnish lodging places for dust and disease-germs and carpet-beetles — one of the things the housekeeper had to consider in selecting a new home to move into was whether her carpets would fit. Mrs. Bumble never has to do that, because she always makes her carpets over after she moves in.

HOW MRS. FIELD-MOUSE HELPS MRS. BUMBLE WITH HER CARPETS

In doing this she generally has the help of Mrs. Field-Mouse. An empty field-mouse's nest makes a lovely home for a bumblebee family, and the field-mouse always leaves a lot of carpeting on the floors that Mrs. Bumble has only to make over to get exactly what she wants for her own needs. The carpet is very soft and nice. It is made from the withered blades of the half-rotted grass tufts in the meadow. Mrs. Mouse cuts them lengthwise into strips with her sharp little teeth, and then divides them into

short lengths which she works up into a kind of felt, like the felt of your hat. With this she covers the floor and walls of her nest to protect the tender bodies of her babies from the damp ground.

What Mrs. Bumble does is to take this carpet up and tear it to pieces, bit by bit, with her jaws. Then, with the help of her first pair of legs, she refelts it, passes it under her body between her other four legs, and piles it up in a heap behind her. She next cuts a hole in the centre of the pile, and, going in, hollows out the oval chambers where she lays her eggs and raises her family.

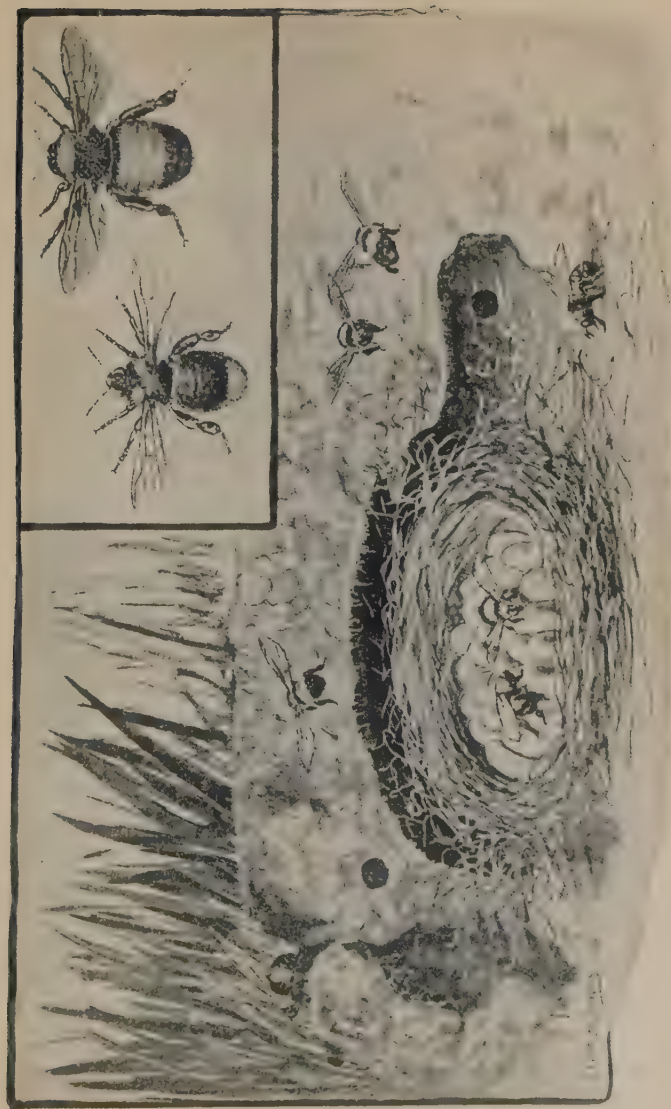
You might suppose some of these bumblebee mothers had heard of spring mattresses, too. In remaking their carpets they frequently mix in a little moss. This makes them more springy, so that they don't lie so close to the ground and take up dampness.

But not all bumblebees do this; a matter of personal judgment, I suppose. There are housekeepers and housekeepers, you know, and some are a good deal more particular than others.

MRS. L. C. BEE'S CARPETING AND WALL-PAPERING

Like her big, buxom relative Mrs. Bumble, Mrs. Leaf-Cutter Bee prefers to take a home already built, so that she doesn't have to bother her head with anything but the cleaning and furnishing. The leaf-cutters, according to species, move into the deserted hall of a burrowing bee, the tunnel of a burrowing beetle in a tree trunk, an empty snail shell, or the hole of an earthworm where some early-morning robin has called.

Having chosen her home, Mrs. L. C. Bee proceeds to car-



HOW MRS. FIELD-MOUSE HELPS MRS. BUMBLE WITH HER CARPETS

pet the floors and to paper the walls and ceiling. The bits which she cuts from the rose-leaves with her sharp little jaws she holds against her breast as she flies home. Arrived there, she lays the lower surface of the leaf next to the wall, because it is the upper surface that is so nice and smooth. Then with her head, with her feet, with her jaws, with her body, she straightens and she smooths and she pushes and she pats and she pulls. There!

For the side walls she cuts out oval pieces of leaf, eight or ten of them for each room. The outside leaves are longer and extend beyond the room at top and bottom. In this way, you see, the leaves that serve as wall-paper and ceiling for one room also serve as a carpet and floor for the room above.

But there are gaps between these oval pieces as they are laid against the walls, and these gaps are filled by overlapping them with smaller leaves. Then, on the bottom, to cover the gaps in the carpet, a few small oval pieces are added also — oh, say two or three.

THE GREATEST USERS OF WALL-PAPER

The greatest users of wall-paper, of course, are the wasps, the kind that live in colonies. And, as everybody knows, they have real paper and they make it themselves. For paper-making material they chew up not only the fine gray film that forms on weathered wood, but tough fibres gathered from the plants that grow around swamps. This fibre, which they used before man came along with his barns and his outbuildings and his rail fences, can be worked into a stout felt that sheds rain and keeps out the cold winds better than wood scrapings.

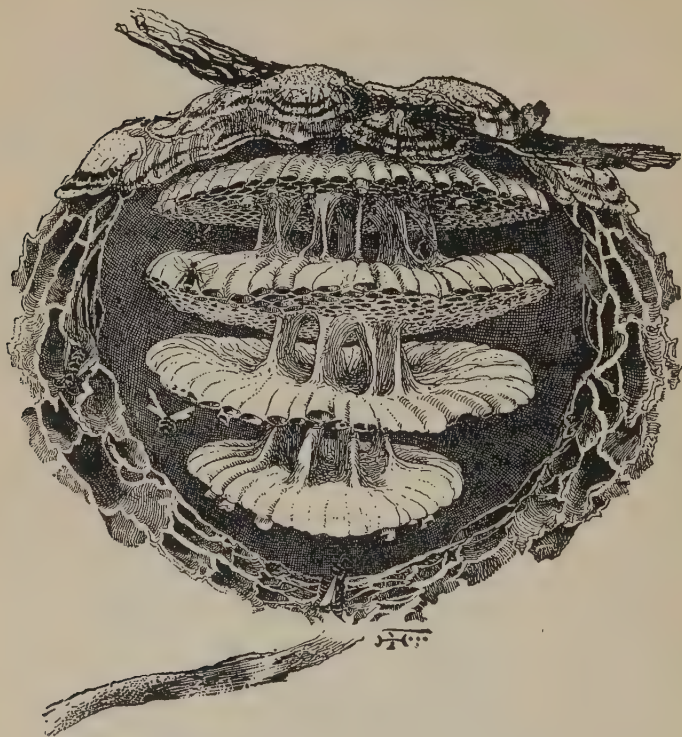
As she gathers her material the little paper-maker mois-

tens it with her saliva, much as boys, by the way, make paper balls by chewing. But much of the saliva dries out of her load as she flies back to her nest. So when she arrives there she moistens and chews it over again. Then she mounts astride one of the paper strips that cover the nest and presses the little ball down with her fore legs until it sticks. Next she presses and kneads the ball into a short cord, moving backward as she works, like a man in a rope walk.

Notice how she flattens the cord, which now lies along the edge to which she has fastened it. With the same tools — her mandibles — with which she gathered the raw material and made it into pulp, she changes it into paper. This she does by going forward to the beginning of the cord, drawing it through her mandibles, and flattening it by a succession of bites. She has to make several trips for this, flattening it more and more each time.

You see, the wasps paper the outside and not the inside of their house as we do and as Mrs. L. C. Bee does. The reason is this: These outer walls enclose the combs within a kind of paper bag, and the entrance is through a hole in the bottom — the gate of the city. As new apartments with their many rooms — the cells of the combs — are added, the bag must be made larger. Now, if human architects had a job of this kind to do, they would tear down the old walls and rebuild. But with the wasps this is out of the question. Think of exposing the eggs and the babies in those combs to cold drafts! Why, even the grown folk are so sensitive to cold and damp that right now, in April, let there come a raw or rainy day, and you'll find them huddled together for warmth on the roofs between the combs. So, although the walls are constantly

being enlarged with the advance of the season, they always afford complete protection to the little citizens within be-



Copyrighted by Harper & Bros.

INTERIOR OF PAPER WASP'S NEST. WHY THE BABY WASPS SO
OFTEN FALL OUT. (See page 280.)

cause the workers gnaw away material from the inside of the wall and, using this, along with fresh material, keep adding to the outside.

HOW THE MUD-DAUBERS PLASTER THEIR WALLS

The mud-daubers are the master masons of the wasp people, and you will find it extremely interesting to watch them also at their work. Their little mud balls, brought from the edge of some convenient puddle, they spread around with the lower lip, guided by the mandibles. The little mason stands astride her work, just as the paper-wasp does when she is papering. With each addition to the cell she adds certain finishing touches, somewhat as the mother robin does in plastering the inside of her nest; but while the bird mother uses her breast for a trowel, the wasp uses her feet, patting the walls inside and out as she sits astride.

THE THREE SONGS OF THE MASON

You can see that Mother Wasp is as happy in her nest-building as Mother Robin is; and, unlike Mother Robin, she sings while she is at work. She has three songs. When she is gathering her clay she makes a loud hum. Then after getting her load, she flies away with a triumphant note, different from the first. At the nest this changes to a cheerful little tune, not so loud as either of the others, as if now she had to do some special thinking:

“Hum, hum! Let me see!”

II. MISCELLANEOUS BUILDING NOTES

Really, there is no end of things of interest to be observed in the work of the housekeepers in this curious little World of the Six-Legged, but in this chapter we will have room for only a few more.

Some of the bramble-wasps, that is to say, wasps that

dig their nests in the stems of blackberries and raspberries, make a plaster that is quite like that of human dwellings; for, instead of using wood dust, as the carpenter-bee does for her room partitions, or mud for the walls, as the mud-dauber does, they use sand, cementing the grains together with their saliva. With this mixture they plaster their walls — the whole inside of each room in the stem.

If you'll watch one of these bramble-wasps in the spring, you'll see her getting ready for the plastering by carrying out loads of pith which she digs from the stem. Then, after it is all done, she takes a day's rest.

Another burrowing wasp, one of the kind that digs in the ground, stands in her door after she has finished digging and washes her face like a cat, rubbing it with her front legs. Then she rests for a good while, gazing up and down the "street." On the ground at the edge of the garden you will come across a little heap of fresh earth, and at intervals see an upheaval from below. There is where one of these wasps is at her work. It takes her from one to two hours to finish it. Then she "opens the door" from below and stands in it as described; for the hole runs into the ground at a slant — it is not perpendicular.

THE BURROWING BEE AND HER SOMERSAULTS

One of the most curious and original ways of disposing of the soil dug out in connection with building operations is that of one species of burrowing bee. After she has bitten out a good armful of pellets, she squeezes them against her breast with her two fore legs, and then, with her other four legs, she climbs carefully up her shaft and dumps her load by turning a somersault. These bees dig their bur-

rows on the slopes of little knolls in the meadow or on the sides of the banks of little gullies. This gymnastic performance, therefore, lands the builder and her armful of dirt at the bottom of the slope. In this way she is able to move what must be a pretty big load for such a little body, a considerable distance away, and with far less effort than if she tried to "tote" it. In a similar way men in railroad freight houses, and stevedores loading vessels — before the days of handtrucks — used to move heavy boxes by turning them end over end.

Pretty clever idea for a little bee?

But even that isn't all of it. I said the bee turns a somersault. What she really does is to turn a *back* somersault. Do you see the advantage of that? When she lands on her feet, after going over and over, she has not only dumped her load, but she arrives at the foot of the slope with her head toward the entrance of her shaft, and can at once start up and do it all over again! This particular burrowing bee, if you want to look out for her, is of a brilliant metallic blue, and is known as the "Blue Digger."

Her tunnels are sometimes over five feet deep, so you see digging one of them is a big job, and she needs to resort to all the engineering devices she can think of to save time and effort; she must make her head save her heels, as the saying goes.

ARCHITECTURE AND ENGINEERING AMONG THE ANTS

That the ants, famous for wisdom even in Solomon's day, should show forethought and skill in their building and engineering work goes without saying, but do you know why they are so fond of stone roofs? And do you

know about their summer houses and pergolas? Well, first about the stone roofs. They are as popular with ants as brownstone fronts used to be with city householders. Even big ant-hills begin modestly with small colonies under a stone. This protects the colony while it is small, and in the case of species such as those that burrow under sidewalks, helps to keep the soil moist so that it can be easily worked.

Now about the summer-houses and pergolas. If you'll look closely in the grass in the vicinity of ant nests you'll see little mounds here and there. These mounds are made along the pathways followed by the ants when out foraging. They serve as "club-houses." The ants gather in them to rest up or to shield their little bodies from the thumps of a sudden, pelting, summer rain. Between these little club-houses are sheltered runways partially roofed over with sticks and stems and bits of dead grass blades. They remind one of grape-arbors or pergolas, and they serve a similar purpose — furnishing nice sheltered walks between the club-houses.

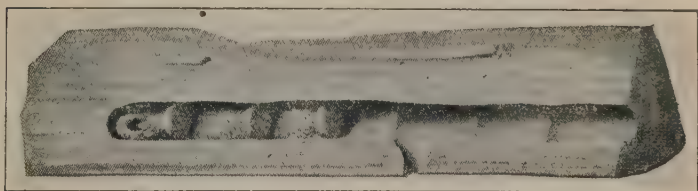
Another interesting thing about ant architecture that you don't find in many ant books is this: If, among the carpenter-ant species some worker makes a room much larger than it need be, other ants manufacture a kind of cardboard by mixing the sawdust with saliva, and then cut up the big room into smaller ones by building partitions of this cardboard!

MRS. CARPENTER-BEE'S FOOT RULE

I simply can't close this section, even if we are crowded for space, without telling you of Mrs. Carpenter-Bee's foot

rule, particularly as there is some controversy about it, and you may settle this disputed question one of these days by discovering something with your sharp eyes that hasn't been noticed before.

Some observers, Fabre among them, doubt if the bee is really measuring, but this is what she does: Before building



Copyrighted by Harper & Bros.

MRS. CARPENTER-BEE AND HER FOOT RULE

one of the partitions that separate the rooms in her little tunnel, she always puts her head against the last partition already made, as if the length of her body told her where the *next* partition was to be built. Then she proceeds to build it. It used to be thought that each partition was made exactly the length of her body away from the previous one, but Fabre found that the first and more numerous chambers were larger than those following; and that in the larger chambers female bees were hatched and in the smaller and fewer cells, the males.

He found, moreover, that there was no uniformity in the sizes of either class of cells. So he came to the conclusion that the object of her measurement was to shorten the distance between partitions as the work went on. But if she's measuring to shorten the distance, she's *measuring*, isn't

she, although her measurements may not be exact. She isn't *guessing*!

For that matter men used to do the very same sort of thing before they had measuring-rules and arithmetics to tell them just how long an inch is, or a foot, or a yard. You have only to look up the word "foot" in the dictionary to see that this is true.

Foot: A measure of length derived from the human foot. A foot was divided into twelve parts, formerly called lines, and into three parts called "barley corns," each of these parts having been declared to be "three grains of barley, dry and round, placed end to end."

III. THE GREAT FRONT-DOOR PROBLEM

In human architecture the front of the house is so important that a great deal of thought and artistic skill is spent on it, because that is the part that naturally attracts attention. But — and I suppose it's a thing not to be wondered at — many of the housekeepers of Lilliputland who live alone and not in one big house, as the ants and the social bees and wasps do, don't want any part of their house to be seen. They not only shut the front door, but make it a point to hide the whole house — door and all! That is why they are so particular about clearing away all the dirt from their door-steps with their brooms and pneumatic cleaners, and so on.

HOW MRS. CLYPEATA CLOSES HER DOOR

But there are exceptions. Take the wasps, for example. Most of them close and hide their doors when they are away from home and open them when they come back

from market. But the Mrs. Wasp of one species does the very opposite — she leaves her door wide open when she goes out — makes it a point to, apparently — and shuts it when she gets back!

The wasps that have this habit belong to the Clypeata species. When Mrs. Clypeata enters her home she closes the door very much as a boy does when he's bringing in a big load of wood for the kitchen fire on a bleak winter day. Having both arms full he can't use either of them to shut the door, so he shuts it by backing up against it.

So it is with Mrs. Clypeata, but her load is the door itself; for she stops the entrance by backing up a mass of earth into it. But when she's away from home, as I said, she leaves her door wide open. Other burrowing wasps are so extremely careful to close their front doors when they're marketing that the only explanation the science people have to offer for the apparent carelessness of Mrs. C. is that maybe the little baby bedrooms that open on the hallway of the burrow are kept closed.

I say "maybe," because the science people, for all their mixing in wasp society, haven't yet found out about this. They reason that it is *probably* so on account of the known habits of wasps and the fact that the people of the insect world, while they have their individual peculiarities and ways peculiar to their "set," as one may say, stick pretty closely to family tradition. But, anyhow, here is another chance for *you* to supply some missing pages in nature's fascinating story.

Of course there is this to be said, and we can imagine Mrs. Clypeata saying it:

"How in the name of goodness am I going to shut the

door from the *inside* when I'm on the *outside*? And you've *got* to be on the outside when you're going anywhere — marketing and the like!"

Yet, knowing something about the ways of other wasps, our impulse is to reply:

"Why, Mrs. Clypeata, if you'd only use your eyes a little more to pick up household hints from other branches of the wasp family, you would see how you could settle this front-door problem as easy as anything."

MRS. URNARIA'S LITTLE STONE DOOR AND HOW SHE SHUTS IT

This, for instance, is how Mrs. Urnaria does it. In starting to dig out the little house for her babies, the first thing she thinks of, apparently, is the front door. So she starts with the door-jamb. That is to say, the first half-inch or so of the entrance to the hole is made slightly larger than the rest of it. Then, when she has dug as deep as she intends to, she looks around until she finds a pebble, picks it up with her mandibles, flies with it to the little home, and carefully lowers it and fits it into its place. Then, rising as high as she can on four of her six legs, she scrapes and throws dirt with her two front legs back and between these upraised legs until the stone is completely hidden.

When she comes back from the meat-market with a caterpillar to put away in the hole, all she has to do is to scrape that dirt away and raise the hidden door.

A WASP THAT USES A TOOL

Isn't it hard to believe that a mere insect should be so clever? But now here's something you're going to find it still harder to believe. It created a great sensation in

scientific circles when it was first announced some years ago, and it went the rounds. In fact, it seemed so incredible that one of the men who first saw a wasp do this thing waited a whole year before making it public, because he was afraid it wouldn't be believed. And he was a college professor, too, head of the Department of Entomology, the department that deals with insects. What he saw was this:

After the wasp had fitted her little stone front door into its place and covered it all over with dirt, she flew away and came back with a smaller pebble. Then, standing up and holding the pebble in her mandibles, she used it to press down the earth she had thrown over the other pebble and smooth it off. But still she wasn't satisfied; for, after the smoothing and pressing were done, she spent several minutes beating the earth down with the stone, "tamping" it much as men use the tamping-iron. The result was that when she was through you couldn't tell the spot that hid her precious home and its little front door from any other spot on the hard, smooth surface of the plain.

You may think it odd to give so much attention to the front door as this little lady did and as other burrowing wasps do in clearing away with their brooms and things all the dirt of their digging. But you wouldn't think it was odd at all if you lived in The Land of the Six-Legged. You see, the idea is just here: Times are about as lawless there as they were a million years ago, and there are certain people hanging about these wasp neighborhoods — not to mention any names — that are always looking for a chance to slip into the little homes and lay their own eggs in the caterpillars that Mrs. Wasp has provided for her babies.

And Mrs. Wasp has made up her mind that she just *won't* work her head off for Mrs. Somebody Else's babies' benefit.

Work! Why, one of these burrowing wasps has been known to go for forty-two hours at a stretch in making her nest and packing it with worms.

Night and day!

This was an exceptional case, to be sure, but it only goes to show!

HIDE AND SEEK IN THE OPEN

(STRANGE AND CURIOUS THINGS TO BE SEEN IN THE LAND OF THE SIX-LEGGED IN APRIL. CONSULT INDEX ALSO, UNDER "MONTH BY MONTH")

Turn up a flat stone in the fields or at the edge of the woods any warm spring day, and you will see the ants and their little green cows; and the cows looking as fat as butter! Greatly excited, the ants will pick up their cows and plunge back into the underground galleries where they have been keeping and feeding them all winter. On warm days the ants bring them up and let them enjoy the sunshine and the warmth of the stone, heated by the sun. Last fall they took these aphids from plants or roots on which they were feeding. They also take the aphid eggs from the plants or roots where they are laid in the autumn, hatch them in their underground nurseries, attend the young during the winter months, and then, in the spring, bring them out and replace them on the kind of food plant from which they were taken!

But wait — that isn't all! Certain aphids make a specialty of wheat, sucking the juice from the roots, but they want their early-spring breakfast food before the spring-sown wheat has sprouted; so what do the ants do but put them, as soon as they are hatched, in the ant nurseries, on the roots of young foxtail grass, smartweed, and ragweed, because, like the rest of the weed family, these weeds are also very early risers. Then, as soon as the wheat sprouts, the ants transfer the aphids to the wheat roots! Read Doctor McCook's "Nature's Craftsmen," and you'll see that every word I'm telling you is true. And listen to this:

"As soon as the roots become tough the aphids, hitherto wingless, give birth to a generation of winged and wingless. The former fly to fresh pastures, and the ants transfer the wingless to younger roots. In some cases the ants clip the wings, whether to prevent escape or to make it easier to get the honey-dew milk has not been determined."

Ants carry aphids from apple-trees to the wheat in the same way. The aphids pass the winter on the apple-trees in the egg state, and are among the most serious enemies of the young wheat. Apple orchards are accordingly sprayed in midwinter to get rid of them.

There are sixteen generations of aphids between April and October, and what with their rapid reproduction and the care given them by the ants, it looks as if there wouldn't be anything left for the rest of us to eat if it wasn't for the ladybirds and other insects that use the aphids for "beefsteak," as the ants use them for cows. The larvæ of many species of the ladybird-beetles live on aphids. The adult ladybirds also eat aphids, and in March and April, about the time the aphids appear, the ladybirds come out from their winter quarters looking for them. In California, where the ladybirds collect in great masses under the leaves in the mountain forests, the fruit-growers gather them by the ton, put them in cold storage and use them at the proper season for controlling aphids. And, speaking of *cold* storage, do you know where Mother Goose got the rhyme:

"Ladybird, ladybird! Fly away home!
Your house is on fire,
Your children will burn."

In England (where Mother Goose, bless her dear old soul, was born) the hop-vines are burned after the harvest, and are usually full of aphids and the larvæ of the ladybirds.

I don't know that the ants ever have any words with the ladybirds because of their attacks on the aphids, but I do say they *would* if the ladybirds ever broke into the places where the ants herd their cows. Like shepherd-dogs, they drive away any insects that attack them. See for yourself. Poke a grass blade or a straw (or your finger, if you want to) into a herd of ant-cows, and the red ants, with open jaws, will rush at you. The "herdsmen" (brown ants) throw their heads back and sit up and squirt formic acid!

Certain small black ants actually fence in the aphids you find

clustered around the axils of the leaves or twigs of trees — apple-trees, for instance. These fences, or walls, are made of particles of leaves, flowers, decayed bark, and pellets of soil. These little black ants you perhaps know by their popular name of “turn belly.” They have the odd habit of turning up their abdomens as they walk.

“Well,” I fancy I hear you say, “after all these fairy-tales of Ant Land, perhaps you’ll tell us now about ants that make butter!”

No, I can’t do that, but I can tell you that they do keep butterfly cows — almost; for they tend and “milk” the caterpillars of certain butterflies, the little blue butterflies you see in the spring feeding on the flowers of various plants. These caterpillars, like the aphids, give out a liquid that the ants like. They are the larvæ of what are known as “Common Blue” or “Spring Azure” butterflies.

As early as April many moths may be seen flying at night, visiting the willow blossoms or attracted to the lights, but the White-Marked Tussock-Moths are still in the egg-cases on the elms and other shade-trees.

In the latter part of April or early in May, depending on the weather, the chrysalides which you have gathered should be brought into the warmth for development. Spread them on a thin bed of slightly moistened sand with some brown leaves and twigs scattered over them to make them feel at home. They should be protected from birds, mice, and squirrels, with a wire-net case set down on the sand. And you should stick in the sand some little branches on which the moths and butterflies, after coming out of their chrysalides, can hang themselves up to dry and prepare their wings for flight.

It is said in one of the popular books on the subject that moths and butterflies are usually born in the morning between nine and eleven, but this is not true. As in the case of human beings, the great event may take place at any hour of the day or night. Doctor Lutz told me of sitting up until three o’clock one morning to watch the birth of a butterfly; and although he had seen the same thing many times, he felt well repaid for his long vigil. Usually a chrysalis is rather active for several days beforehand, particularly if disturbed, and this is a sign that it is in healthy condition. It may be said to “dance” in a wiggly way! (In anticipation of the birthday parties and the sun dances of the butterflies and the moon-light dances of the moths, do you suppose?)

At any time during the winter, too, if you pick it up and hold it close to your ear you are quite likely to hear movements inside a chrysalis — stirring in its sleep!

By April, among the worst enemies of the garden and orchard that will be stirring are certain burglar caterpillars, the noise of whose “burgling” you can hear without picking them up; in fact, if you pick them up you *can’t* hear it, for one of their tricks is to play ‘possum when disturbed. I refer to the cutworms, and I call them burglars because they commit their depredations at night, and you can find them during the day just under the surface by scraping the loose earth around the plant with a little stick. If the garden things aren’t up yet they seem to suddenly say to themselves:

“We have legs for climbing, like other caterpillars! Why not use them?”

So they climb the orchard trees and the grape-vines and the berry bushes and eat the fruit-buds and the leaf-buds. Newly set-out orchards are killed in this way if one is not on the watch. For a long time it was a mystery as to the authors of this destruction, for there were no enemies to be seen about in the daytime, the cutworms always going back to bed in the ground after their nightly depredations. But one night a man, going through his vineyard, heard a queer noise, as of the gnawing of innumerable little jaws. He got his lantern and, looking about, found that his vines were just covered with cutworms!

I have already told you of one way of getting rid of them in the garden, by scattering poison mash over the soil. Individual plants can be protected by putting cones of stiff paper around the stems, with about an inch of the cone in the earth and two or three inches of it above. Finding this obstruction around the root, the worms are, as a rule, not smart enough to think of climbing over or digging under it, but if food is scarce they sometimes do both, necessity being the mother of their invention, apparently. Young trees can be protected in a similar way, and to some extent with stiff-paper funnels, or with the tin of cans from which the solder has been melted.

The Indians used to get rid of cutworms in their gardens by scraping them from around the roots, in the way I have described.

Another enemy of mankind, the house-fly, is now coming from its hiding-places and laying eggs in refuse heaps or manure piles which ought to have been spread over the fields.

Larvæ of the mud and digger wasps are changing to pupæ in their mud cells and earthen burrows, and will soon be hunting caterpillars and other forms of breakfast food for wasp babies.

Queens of the hornets and the yellow-jackets and brown wasps are starting their nests.

Ground-beetles, hidden away under the stones and the logs and other shelters, are beginning to wonder if it isn't time to get up after their long winter sleep, and many of them actually do get up and about.

Canker-worms and bud-worms have begun feeding on the opening apple-buds. Currant-worms are laying their eggs on the under surface of the leaves of the currant-bushes.

Coral-winged locusts, nearly grown, may be seen hopping about. Grouse-locusts, if the month is forward, begin egg-laying.

Termites, or "white ants," establish their colonies in stumps or logs or in the ground, like the true ants, which they so much resemble, and become very busy by April. The termites, although they look so much like ants, are more closely related to the cockroaches. They have wonderful establishments in the tropics, but because these stories of the six-legged deal almost entirely with the insects of our own land that you can observe for yourself, and because I have already dealt with the termites in "The Adventures of a Grain of Dust," I did not include them among the insect republic people in the February chapter.



Courtesy of the American Museum of Natural History

ANTS DEPORTING FELLOW WORKERS DURING MIGRATION

CHAPTER IX

(MAY)

HOUSE HUNTING AND MOVING IN LILLIPUT- LAND

May and its moving days are fully as busy a season in Lilliputland as they are with us, and the ideas of the little housekeepers, many of them, are like ours in ways that one would hardly expect, the preference for south and east fronts, for example. And, as in the human family, some always insist on building — “the only way you can get things to suit,” they say. Others build only when they can’t find what they like; or, having found a place, learn that it is already taken. Some go in for big houses and let out rooms, while others prefer something small and cosey, like an oak-gall. A certain housekeeper I know will settle down quite contented and raise her little family in a hickory-nut shell that a squirrel has vacated and made ready — around about meal-time, some day or other. She is to be found in the Middle Atlantic States, and I don’t

know where else. But it's a good thing she doesn't have to take her full name with her into that tiny cottage! It's *Leptothorax curvispinosus*. How could she?

I. HOUSE HUNTING AMONG THE BEE PEOPLE

Along in late April or early May — it all depends on the weather — if you see Mrs. Bumble skimming along close to the ground she's probably looking for a "To Let" sign. An empty field-mouse's nest, as we have seen, makes a lovely home for a bumblebee family.

HOUSE-HUNTING TROUBLES OF MRS. CARPENTER-BEE

Did you hear that big bee that just bumbled by? I thought at first it was a bumblebee, it was so big and it bumbled so! Didn't you? I see now that it is Mrs. Carpenter-Bee. Evidently she's house hunting. I hope she finds what she wants. But one can never tell; there's always *such* a demand for houses in the spring. And on this lovely day everybody is out looking around, you may be sure. The Carpenter people will have nothing but a frame house, yet they don't insist on building for themselves, as one might naturally suppose they would. They are always glad to move into a place that's already built — provided it's in proper condition, of course, with good, sound wood floors and all that.

There, she has found what she wants. See her going through the front door? I mean the entrance to that little hole in the door-frame of the wood-shed.

Zing! Out she comes! She has also found something she *didn't* want — a carpenter-wasp. Mrs. Carpenter-

Wasp likes a ready-made house when she can find one, and was back at the end of the hall when Mrs. Carpenter-Bee came in.

"How should *I* know she was in there, the ill-tempered creature! But the Wasp family are all so waspish!"

That's what we seem to get out of Mrs. Carpenter-Bee's mumbling bumble as she flies away. But, anyhow, after a few more experiences of this kind — several times she was chased out by other Mrs. Carpenter-Bees who had started their house hunting a little earlier — she decides to build. She found plenty of old tumbledown places, to be sure — holes in rotten wood — but these she simply wouldn't think of!

"Tenement-houses *I* call them," says she.

Although the carpenter-ants build in wood that is somewhat decayed, the carpenter-bees, true to the best traditions of the carpenter craft, will have nothing but sound wood to work with. So our carpenter starts her new home in the window-sill, there by the porch door.

THE LADY OF THE BRAMBLES

There is another carpenter-bee much smaller than this one — her metallic blue body is only about a quarter of an inch long — who builds her nest in the stems of wild blackberry and raspberry bushes. We have already learned something about her and her nurseries. The blackberry and raspberry bushes are often referred to in English literature as "brambles," so let us call this bee "The Lady of the Brambles," after her country place. The longer, larger shoots die in winter, and by spring furnish just the kind of good, seasoned lumber that my lady wants. She looks un-



Copyrighted by Harper & Bros.

POTTER WASP AND HER NEST

til she finds a nice, big, stout stem that has been broken off by the weight of winter ice or snow, or by the winter winds, and, beginning at the broken end, starts to dig out the long hall which, like other carpenter-bees, she later divides by snug partitions into those little rooms for her babies that we read about in the April chapter.

THE LADY OF THE ROSES.

What fairy scissors have been at work on the leaves of that rose-bush in the front yard? They have little rounded pieces cut out of them, as if some very small body were making a green-leaf dress for a moonlight party in Elfland. This must have been the work of the leaf-cutter bee, one of the species that makes a specialty of rose-leaves. "The Lady of the Roses" is somewhat like "The Lady of the Brambles" in choosing her nest site, but she builds in the ends of dead twigs of sumach, elder, and other bushes, as well as in bramble-stems. So she is, in a way, a carpenter-bee, but she is known because of her extraordinary skill in handling her scissors — her mandibles — as the "leaf-cutter bee." Sometimes the leaf-cutters dispense with the carpenter work altogether and snuggle their thimble-shaped baby beds under the shingles. Some species line their nests, not with leaves but with pieces cut from the petals of the roses, and from pansies, too; and other flowers. A rose-leaf bed for a baby! Who but a fairy, or one of these fairylike little mothers, would ever think of it?

THE HOUSE-BUILDERS OF BURROWBEEVILLE

The leaf-cutters also differ from the carpenter-bees in their habit of burrowing into rotten stumps when they can't find just what they want in the way of a dead twig. The burrowing bees proper are those that dig their long halls in the ground, with baby bedrooms opening on the halls. These bedrooms are the last word in sanitation, for they are glazed like the walls of a bathroom. Each bee digs her own burrow, but the burrowers frequently live in large neigh-

borhood groups. There may be thousands of burrows in a square rod. Some of these burrowers also are as large as bumblebees, but one species is the smallest of all the bee family, smaller than the bramble lady, who herself is only

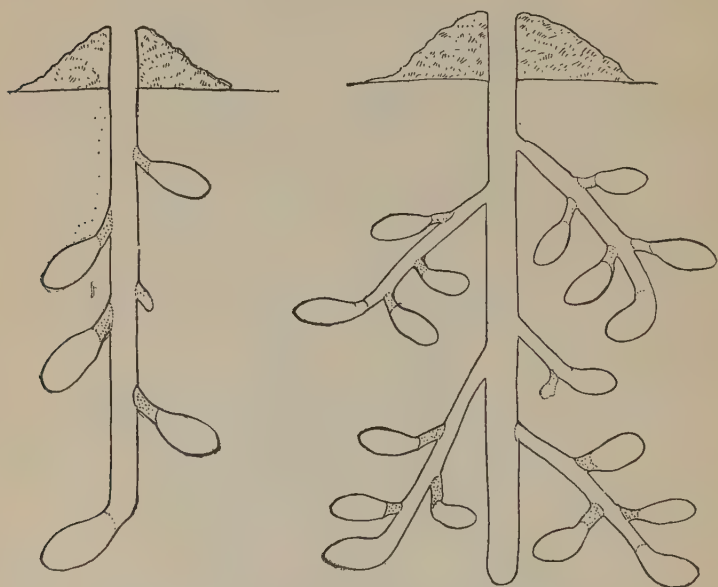


DIAGRAM OF NESTS OF BURROWING BEES

a quarter of an inch long. These smallest of the burrowers are the ones whose little front doors pepper the face of clay cliffs, the walls of railway cuttings, banks by the roadside or brooks, and the sparsely grassed clay knolls of pasture-lands. The front yards of Burrowbeeville only have a tuft of grass here and there, and that of the coarsest, wiry kind,

because the soil is so hard and dry, but such soil is just the thing for digging burrows that won't cave in on you.

THE HONEY-BEES AND THEIR GIRL SCOUTS

Among all these classes of bee people we have been speaking of — the bumbles, the carpenters, the leaf-cutters, the burrowers — each housewife picks out a place according to her individual tastes. They are all what are called "solitary bees." With the hive-bees, on the other hand, as in everything else, house hunting is a family affair. Their house hunting is done at swarming-time. And May, this very month, is the most important swarming-time of the year — from the bee-keeper's standpoint, at least. You've heard the old saying:

"A swarm in May is worth a load of hay,
A swarm in June is worth a silver spoon,
A swarm in July isn't worth a fly."

It's a true saying. At the end of six or seven weeks of hard work a bee has reached old age and soon dies. The bees that were hatched the previous autumn, however, have never done any work to speak of, and wake up in the spring full of energy. These are the ones that make up the May swarms.

So the bee-keeper is anxious to get them into a new hive as quickly as possible. Unless they are transferred at once, a number of the bees start on a scouting expedition — they are *girl* scouts, of course — and they go in all directions looking for a new home. Then they keep coming back, and, in some sort of language that the bees evidently understand, they report on the likely-looking places they have seen to the Pilgrims gathered for departure. One has

been particularly impressed with the accommodations in some hollow tree, another knows of just the thing in some heap of boulders in a distant field; and back in Samson's time, some bee-body must have known how to tell the others about the advantages of a certain dead lion's frame — a fine mansion with beams and rafters done in gray and a roof of leather; the bones nicely bleached and the hide tanned in the sun of that hot, rainless land, where, as in our own deserts of the great Southwest, flesh dries up but does not decay. You remember Samson afterward found handfuls of honey there and passed it around and made up this riddle:

Out of the eater came forth meat and out of the strong came forth sweetness.

With all the facts and arguments brought in by the official house hunters to take in and turn over in their wise little heads, it often keeps these New England town meetings of the bees quite a while before they can decide. The girl scouts will come in one day, and the other bees think it over and talk it over until the next morning. But once a decision is reached there is no more talking and arguing. The debate is closed.

“Let's go!”

And they're off with a rush; over the fields and far away — straight to the chosen spot. With the girl scouts in the lead, I suppose; for who else would know the way? The new home is usually very distant — not in the neighborhood that the workers have learned so well in their daily marketing and which seldom extends more than a couple of miles from the hive.

THE ALARM-CLOCK IN ANTLAND

One particularly interesting thing in connection with moving-day matters among the ants is that, like most housekeepers, they prefer a south-and-east front. Look among hills or on rolling prairie land, and see if you don't find most nests on slopes facing south and east.

But the reasoning of the ant mind is not quite that of the human mind. My impression with regard to the human housekeeper's preference for a south-and-east front (my girl readers will correct me if I am wrong) is that, in summer, the back part of the house is cooler in the morning, when one does most of one's housework, while in the afternoon the front part of the house and the living-rooms are in the shade. The south frontage gives more breeze in the summer, when most winds are from a southerly direction, and in the winter gives more light and sunshine, because the sun's course is then to the south of the zenith.

The ants prefer a south-and-east front, because the morning sun not only wakes them early for the day's work, but takes the chill out of the air and brightens them up. Sunshine is to bees, ants, wasps, and most other members of the insect world who live above ground, what tea or coffee are to human beings — it stimulates them. At the same time you can get too much of even so good a thing as sunshine, and on a blazing afternoon ants are glad the sun is on the other side of the hill.

THE GYPSIES OF THE ANT WORLD

But how different people can be! People of the same blood, I mean — ants, for example. While the common

ants we find under the stones and beneath the little circular mounds of our pathways are such home bodies, there is at least one tribe of ants — there may be others — that is everlastingly on the move, like certain other people of independent means that I know. One meets these people in New York to-day; within a fortnight they are in London, and the next time one hears from them they are in Paris or Rome or Cairo — goodness knows where! No matter where they are, they seem always to be getting ready to go somewhere else.

Well, these ants are like that. They haven't any residence, truly speaking. Camping under a stone to-day, a log to-morrow, then to the country place of some home-keeping family of ants for the week-end, and off again! Such is the life of the ant-gypsies — the *Dorylinæ*. They really haven't any wide social connections, as one might think from this habit of stopping over in the homes of other kinds of ants. The plain truth is they are known as a hard lot — freebooters, soldiers of fortune — and nobody dares say them “nay.”

Curiously enough, although they are such fighters and robbers, they are, like that terrible man in “Treasure Island,” as blind as bats. But, like the bat, they make up for lack of eyesight by a very delicate sense of touch.

CAMP-FOLLOWERS IN THE ANT ARMIES

Like other armies, these blind warriors have their camp-followers. With these powerful marauders there is always an abundance of food to be picked up in the path of their pillaging, and that's the secret of the pilfering hordes that accompany them on their marches.

You won't meet any of these mediæval swashbucklers unless you happen to be a bit of a traveller yourself, for they are natives of the tropics, but in the Southern States there are fighting ants and they too have camp-followers who mix and move on with these restless caravans. In Colorado, also, Doctor Wheeler found two tribes of ants that live off the country in the same way — the one tribe doing all the fighting and plundering, and the other sharing in the spoils.

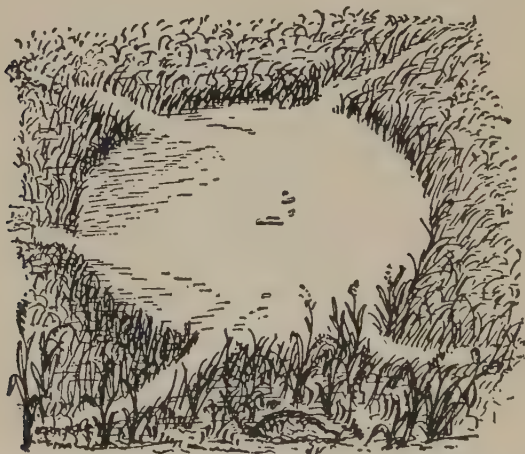
Now, speaking of these fighting ants and their camp-followers, it's one of the strange things about people — ant people and other people — that when close relations have a falling out there's the bitterest quarrel in the world. But ants are a good deal worse than human beings in that way. Neighboring colonies of ants of the same species are always bickering about something — about nothing half the time, as far as I can see — and whenever two companies from neighboring communities happen to meet on the public highway there's pretty apt to be a pitched battle.

BIG ANTS THAT LET OUT ROOMS TO LITTLE ANTS

Yet where the ants are of different species, they often live together, right under the same roof, and never a word!

The fighters and their camp-followers, for instance, are two entirely different species, and out West, in the Rocky Mountain regions, there is a small ant that often builds its little craters in the big nest cones of a much larger ant, one of the harvesters. In the case of these two species there are no openings between the rooms of the landladies and their tenants. In other cases, as in that of the small yellowish red ant that nests in the great dirt and rubbish

mounds of the red ant, the rooms of the tenant are connected by narrow halls with the galleries and chambers of the owners. When the big people move, their little tenants march along with them, carrying their belongings. If there



Courtesy of the American Museum of Natural History

CENTRAL FIELD AND ROADWAY OF AGRICULTURAL ANTS

is any trouble in these apartment-houses it seems to come, not from the owners, but from the little tenants, and yet never a cent of rent do they pay, and nobody asks them to.

In the Berkshires last summer I came across an establishment of this sort. Some ants had dug out their little homes in the mounds of another ant which nests in bog-lands and clumps of moss. These little apartments were connected by narrow, crooked hallways with those of the owners. But while the little tenants dropped in on the proprietors whenever they felt like it, they'd get as cross as anything

if their big-hearted hosts came into *their* part of the house!

If you have an artificial ant's nest — and it's a very simple thing to have and most fascinating to study — you will often see the big red ants break through into the chambers of their little tenants and try to pet them with their feelers. But, no, sir! The little fellows seize their unwelcome visitors by the jaws, feelers, or legs — whatever comes handy — and pull and tug at them until they take the hint and go back home. Then these inhospitable neighbors repair the broken wall — make it all solid again — and cut little openings into the main hallways; gates that *they* can get through but that are too small for the bodies of their big friends!

Did you ever?

And it's a mighty lucky thing for little Mr. Yellow Ant, let me tell him, that these big red ants are so good-natured about it; for the big red fellows are among the fiercest warriors in all the ant world.

THE OAK-GALL HOUSE AND ITS QUEER FRONT DOOR

I must mention another ant of warrior blood who is notable, not for the size of his house and the way he keeps his tenants, but for the *smallness* of his house and the way he keeps the front door. The ants I refer to, instead of roaming all over creation as do the Dorylinæ, or building big houses like those of the red ant, make their homes in oak-galls, and there they live as happy and contented as Mrs. Leptothorax curvispinosus does in her hickory-nut, or as Mr. and Mrs. Peter Piper did in their pumpkin shell!

But if you are thinking of calling — and I wish you would



DIFFERENT KINDS OF OAK-GALLS

— you must know about the funny front door and the pass sign.

The soldiers of this family have odd-shaped heads — something like an Egyptian pyramid with the top cut off. One of these soldiers always stands with his head stuck in a hole in the gall, which is the family front door. And

the top of his head being rough, like the skin of the gall, a stranger might pass that way a dozen times and never suspect there *was* a door. He'd think it was all gall. (This about "all gall" is a joke which you'll think extremely funny, I trust, when you take up Cæsar in high school.)

But now suppose we know the secret of the hidden door — being this kind of an ant ourselves — and have been out foraging for the family on the branches of the oak. We come back and we want to get in. We simply reach up and stroke the top of that queer head with our feelers, our antennæ, and presto, the door swings open! The soldier sentinel takes his stopper head out of the hole, steps to one side as polite as you please, and we walk in.

When we want to get out we use practically the same pass sign — only it's turned the other way around. We approach the sentinel respectfully and stroke his back — much as you would stroke a pussy-cat. Then he takes his head from the doorway again, steps aside, and out we go.

HIDE AND SEEK IN THE OPEN

(STRANGE AND CURIOUS THINGS TO BE SEEN IN THE LAND OF THE SIX-LEGGED IN MAY. CONSULT INDEX ALSO, UNDER "MONTH BY MONTH")

Well, did you guess the answer to the time-lock puzzle that I asked you in February? Or have you already turned to this page and found the answer? If not, now is a good time, in your observation hive, to watch the princesses getting born, for May is the height of the season in Beeland, and there are many Queens of the May coming out into the beautiful world of flowers.

The answer to the "time-lock" puzzle is simply this: The wax cap of the birth chambers of the princesses is made so thick that, unless the workers help by cutting most of it off, the princesses can't cut their way out from the inside.

After the workers have decided that the time has come for a given princess to be born, this cutting away of the wax takes place a day or two before her coming-out party, and about the fifteenth day after she was put to bed at the end of her wormhood. At this time, if you hold to the light a royal cell from which the workers have cut a portion of the cap, you can see the princess moving about and can hear her trying to unlock this "front door." Pretty soon you'll see the end of her mandibles sticking out through the wax. She turns over in bed while doing this, and the circle she cuts is almost as perfect as if it had been done carefully with a can-opener. Since she pushes at the door as well as works her "door-keys" (her mandibles), it finally swings open, like any door; for it has a hinge, the part that hasn't been cut away.

But even after the cap has been cut through, if there are signs of trouble with the old queen or with other princesses who are already "in society," the workers will keep the gate closed. And a princess, after opening her door and looking about timidly, will often go back and stay for some time. After they come out the princesses go about making a kind of piping sound — "zeep, zeep." All are apparently saying something like:

"I'm to be Queen of the May, mother, and anybody who disputes it I hereby challenge to mortal combat."

"Quahk! Quahk!" says the Mother Queen; which being interpreted by the bee-keepers, means: "We'll see about that!"

And, surrounded by her body-guard, she goes around hunting the newly born princesses and the cells of the princesses still behind their doors, with intent to destroy them. This war-cry, this "quahk," little as it looks in cold type, as the bee scientists spell it, sounds to Mr. Maeterlinck "like the peal of a distant silver trumpet."

The workers usually prevent the queen from attacking her royal daughters; but, at other times — apparently this is when they don't want any more swarms for the time being — and in the interest of peace in the hive, they not only permit the queen to destroy the princesses and the princesses to kill each other, but they themselves destroy the royal highnesses. The royalties never use their swords, their stingers, on the workers, and the workers never use their weapons on royalty; it is an unwritten law. In putting princesses to death the workers smother them by collecting around them in a ball and closing in. "As if," says Maeterlinck, "no one bee wished

to be guilty of the regicide, and by this collective movement they make it the combined and official act of the commonwealth."

Yet while they don't hesitate to place her under restraint when they wish to protect the princesses, the bees, in their ordinary relations with the queen, show her all the devotion and deference, and even employ something of the pomp and ceremony which mark the treatment of human sovereigns by their subjects. Even when they are pushing her about to keep her away from the princesses, the moment they hear that silver trumpet, "they wait with bowed heads," says Maeterlinck, "until the sound ceases."

They always avoid turning their backs on the queen, and when she is going the rounds of the brood-cells laying her eggs, the moment she approaches a group of workers they turn their faces toward her and walk away backward, much as a lady does after she has been "presented to the queen" in England.

Odd, isn't it?

When a queen dies, or for any other reason a new queen is brought to a hive, there is danger that she will be attacked as a usurper. But if the bee-keeper is a diplomatist in introducing her — there are certain ways of doing it known to bee-keepers — the bees seem to think it is their own mother queen who has come back, and they give her a royal banquet. They even have a reception committee and a dance — with music and everything! This is how Maeterlinck tells it:

"One section will form a line for her to pass through; others, with head bent low and abdomen high in air, will describe great semi-circles before her, throbbing with sound."

Watch the co-operation between the queen and the workers in connection with the laying of the eggs. The workers go ahead and build the cells, and the queen follows methodically step by step, laying eggs in them. Notice how excited the workers are, as if it were all a kind of game, to see whether they can make cells faster than the queen can lay eggs in them; and once in a while they do get a good many cells ahead of her. When all the cells are completed and she has gone all the way around, does she stop? No, indeed! She comes back to the first cells and begins laying again, because these cells will by that time be empty. The bees have been born out of them and gone to work!

If you see bees coming and going at the entrance to the hives, but only flying a short distance, they are probably young bees hav-

ing their childhood play spell "in the front yard." When a week or ten days old they take their first flight, and most of them keep pretty close to the front of the hive, and, says Mr. Root in his "Encyclopædia of the Bee," "their antics and gambols remind one of a lot of young lambs at play."

Youngsters a little older you'll see searching the crevices of old walls, tufts of grass, or the leaves of plants instead of the flowers. Why, do you suppose? Because, as I said in the September chapter, they haven't yet learned the way to the "candy shop," the nectaries of the flowers.

And apparently young bees, like other youngsters, are given to "showing off" at times. Listen to this: "Before it begins to gather nectar a young bee must learn to gather pollen. It brings in its first load of pollen when about two weeks old. But, instead of going straight to the hive, as the older bees do, it does a vast amount of circling around the entrance. Even after alighting it will take wing again, and on finally entering the hive jostle the nurses, the drones, and the queen, as if to call attention to its wonderful achievement!"

Watch a bee — any bee, young or old — that has just left a flower from which it has gathered pollen. You will notice that it hovers in the air for a few seconds, and if you are keen of vision (who has such keen eyes as a boy or girl?) you will see that it makes swift passes with its legs. In doing this it is stuffing the pollen into its "pockets," the pollen baskets on its hind legs, but just how this is done has not yet been settled. Each of these legs, in addition to the baskets, has a comb on it. Some observers think it crosses its legs (in making the passes above referred to), so as to scrape the pollen from the hairs of the opposite leg, where it is first collected by the bee, and puts it in the basket of that leg. Then the legs are crossed the other way, and the same service done for the opposite leg.

While young bees are playing outside the hive, see if you can hear a peculiar note — "shu-u-a" — that's the way it's spelled by Bastin, who says in his book on insect life that this is an "expression" peculiar to young bees at play. It sounds like the slang word "sure." If bees used slang it would be at this period of their lives. Don't you think so?

Within the hive during the very active hatching period in May, the sound you are supposed to hear is spelled by the bee linguists

"Wuh-wuh-wuh"; although that seems more like an Indian word to me!

When a swarm is leaving (I am still quoting the bee linguists) they say "Shusi," which one might suppose was Japanese for "good-by."

"Brr-brr-brr" probably means: "Get out of our way, you lazy things, and stay out!" It is heard only when drones are being expelled.

If last fall or as late as March this spring you collected any raspberry and blackberry stems with the little plugged-up doors in the end, already described as the work of "The Lady of the Brambles," you can, by carefully paring away the wood on one side of the stems, see the little eggs and the birthday cakes, and later see the worm babies eating their cake.

Small groups of ants, just starting their colonies — and there will be many such in May — seem to realize what small and defenseless nations they are. Until they have formed into a pretty good-sized United States by the increase of the population they are exceedingly timid and take the greatest care to hide their nests. The pellets of earth they dig out, instead of being piled about the nest opening, as they are when the colony is larger and confident of itself, are not only carried quite a little way from the nest opening, but are scattered about. The entrance itself is often kept closed with a few pebbles — the wasp front-door scheme, modified to suit the ideas of the ants!

Or the entrance may be hidden in a tuft of grass or under a dead leaf. And yet do you know how you can find the little nests, in spite of all these precautions? Follow an ant that is going along all by itself with something in its mouth. It's returning from a foraging expedition, and will go straight to that hidden nest.

The red ants, who retired to their winter residences in the fall, move to their summer homes in open, sunny places in April or May.

Currant worms will by May have hatched from the April-laid eggs and be feeding on the leaves of currant and gooseberry bushes. Some species of cutworms are pupating (changing to the chrysalis form) in the soil.

Ground-bettles are going about by hundreds looking for cutworms, and you'll see Tiger-Beetles running around in sandy places. The June-bug Beetles are laying their eggs in grass-lands and feeding on leaves by day, and at night bumping around the lights.

Long-horned beetles are pupating in their burrows in the trees and logs.

May is a good time to watch for click-beetles and see how they "click" (p. 115). You'll find them sipping nectar in shallow blossoms.

Mrs. Ladybird-Beetle is laying eggs in the barks of trees while the leaf-beetles are laying theirs on the leaves, on which the young will feed.

On many flowers you'll see a "bee" that isn't a "bee"; it's a bee-fly, but looks so much like a bee that it is often mistaken for one. It's a fuzzy creature, and has a way of hovering in mid air and suddenly darting away and then hovering again. Like the bees, it is fond of nectar. That's why you see it on the flowers.

Another kind of fly that is sometimes mistaken for a mosquito, on account of its long legs and long body, is the Crane-Fly. One species you can see in May, flying slowly over grass-lands. Another species is wingless, and is often seen travelling over the snow.

May-flies will appear in large numbers by the latter part of the month. Although it takes three years for some species to pass from the egg to the adult or winged stage, the winged life may last for only a day — for a night, in fact. Some species dance a part of the night of the day on which they are born (into the fully winged state), mate, lay eggs, and die before morning!



"HOPPERDOZER" FOR CATCHING GRASSHOPPERS

CHAPTER X

(JUNE)

THE TRUTH ABOUT THE ANT, THE GRASSHOPPER, AND THE SUMMER BOARDERS

There is a story that has been going the rounds for a good while — a couple of thousand years, at least — about a certain grasshopper that went to an ant for something to eat. She was hungry — oh, *so* hungry — and fairly shaking with the cold. (She had nothing on, mind you, but her green summer dancing gown and that thin cloak the grasshopper people all wear, and this was a dreadful raw day, with winter setting in.)

Only a few mouthfuls — a grain of wheat or so — that was all she asked. You've heard about it, I'm sure; and how the ant asked what she'd been doing all summer that she hadn't put anything up. And when the lady in green said she'd been singing —

"Well, then," says the ant, "*now* you can dance!"

Just that sarcastic! And she wouldn't give her a bite!

Well, some friends of both parties have been looking up the facts and there's nothing in the story at all; absolutely made out of whole cloth, as the saying goes.

I. THE GRASSHOPPERS AND THEIR WAYS

First of all, nobody has ever been able to find out who the grasshopper of the story was; whether she was what *we* call a grasshopper, or whether she was the big creature of the blazing midsummer whose song sounds like an alarm-clock going off. We call it the "harvest-fly" or "dog-day cicada"; and the kind that comes every seventeen years, the "seventeen-year locust," although it isn't really a locust at all. Locust is another name for "grasshopper," although more commonly applied to the grasshoppers that travel in swarms and eat up the crops.

You see, the deeper we get into this thing the more the plot thickens, as they say in the story-books. As another instance, take the fact that the singer, whether it was a grasshopper or a cicada, would have been a male and not a female. The Greeks, who were fond of the cicada's song and even wrote poetry about it, had this line in one of their verses:

"The cicadas all have voiceless wives."

WHEN THE WINTER DAYS COME

It was among the Greeks that the story of the ant and the grasshopper started, and it was passed on by Æsop. As a fable it is all right and teaches, among other useful lessons, that it is much better to be an ant than a grasshopper when the cold comes; for while the ants are snug

and well fed in their winter homes, the grown-up grasshoppers all die of having nothing to eat and no place to go.

And that's another reason why the story can't be true — there are no grown-up grasshoppers in winter, and if there were they wouldn't find either Mrs. Ant or any of the Miss Ants at their front doors. The ants would, by then, have gone South with all the rest of the family — that is to say, to the bottom of the nest below the frost-line.

Furthermore, neither a grasshopper nor a cicada would ever be so modest as to ask for a *single* bite of wheat or a single bite of anything; for of all hearty eaters — and the insect peoples have marvellous appetites — the grasshoppers are among the most so! One reason is that baby grasshoppers, instead of wrapping themselves up in baby blankets after their first meals and taking a good long nap, as most species of insects do, begin eating from the time they are born and keep it up all their lives. They don't pass through a worm and cocoon stage, but are born small, just as we are, and grow up. A baby grasshopper is as much like a grown-up grasshopper as a baby chicken is like a grown-up chicken.

THE HOPPERS THAT PLAGUED THE PHARAOH

There are two main branches of the grasshopper family, the ones with long feelers, such as the meadow grasshoppers and the katydids, and the ones with short feelers. The short-feeler folks are also often called "locusts." The locusts, you remember, were one of the plagues that fell on Egypt. They have been plaguing the world ever since. Wherever their flying fleets descend they "cover the face of the earth" and strip the leaves of "every tree that grow-

eth out of the field," just as they did in the Pharaoh's day.

In the Central and Western parts of the United States, where they used to eat up the crops, they seldom appear now in large numbers, because, thanks to irrigation and dry farming, the land is kept ploughed up where their ancestors laid their eggs. But they still devour the fruits of the farmers' toil in the countries of the Orient and in Africa; and, as in Bible days, "the land is darkened" by their unnumbered hosts. A column has been seen in India, for example, several hundred miles long and dense enough, in parts of it, to hide the sun. These air-raiders are much larger than the ordinary grasshoppers of our fields, and the air is filled with the roaring of their wings. People actually have to shout to make themselves heard. The big Rocky Mountain Grasshopper belongs to this tribe.

These big destroying locusts, like the robber Arabs, make their home in desert places and their livings by swooping down on other peoples' cultivated lands. Like the Arab wanderers, also, they feel that there is no place like home — the home of their ancestors in the endless wastes of burning sand. They actually appear to be sentimental about it! Not only do the locust hordes come out of the desert in the first place — as did the locusts of Pharaoh's day — but when swarms are bred in farming regions, where the parents have stopped to eat, the children return to the desert, riding on the wind.

"HOW'S THE WIND?" SAYS MR. HOPPER

And, as the girl scouts among the bees go out to look for new quarters for the swarm, the locusts, before starting,

make trial flights to learn the direction of the wind, the currents of the upper air. If the wind isn't right they come down and wait for a change. They want a wind that will take them over the regular grasshopper line, back to the desert. They will patronize no other.

"The locusts have no king," says Solomon, "yet go they forth, all of them, by bands."

It was an east wind (which must, therefore, have come over the Arabian desert) that brought the locust plague on Egypt. And a west wind carried them away, unfortunately — from a locust standpoint; these west-bound passengers, you remember, were all cast into the Red Sea. The wind must have suddenly died, for swarms are sometimes carried for a thousand miles and more and have been known to settle on ships 1,200 miles from shore.

If the Red Sea were not so wide these Arabs might even have crossed it on foot, for the travelling tribes do cross streams on foot. For instance, in describing the movements of these locust hosts in Africa, one writer says:

When a river bars the way, the front ranks fearlessly cast themselves upon the water, clinging together, pile upon pile, until a bridge of living insects forms, and the rear ranks march over them.

THE HOPPER PONTOON BRIDGES

"But why don't they fly across?"

Because their wings aren't yet ready for business. One of the most striking things about this way of crossing streams this writer has neglected to mention; and that is that in all such cases these bold adventurers aren't grown grasshoppers but babies; no, not quite babies, but what

you might call youngsters — about the sixth-grade age — half-grown hoppers whose wings are not yet long enough for flying.

They do this sort of thing when obeying the powerful and mysterious impulse that moves the birds at migration time. The young locusts are on their way back to the home of their fathers in some dry and dreary region in the central table-lands of the great African continent. Born from the eggs of the swarms that came just before them, they set their faces toward the motherland, and, having eaten everything in sight, move on. Of those that don't walk across on the pontoon bridges made by the bodies of their comrades, many are floated by the current and cast ashore on the opposite bank; many are drowned, to be sure; but there is no roll-call — so far as I can learn — and there are millions of them; they are probably never missed.

It seems likely that such little Arabs — and the big Arabs, their parents — would never leave their desert home at all, they're so fond of it, if it wasn't that they just have to, in hard times, to get something to eat. They lay their eggs not by millions, but by billions. For instance, in the island of Cyprus, where an army of occupation stopped in 1883, 5,076,000,000 egg-cases were collected in the attempt to get rid of them; *egg-cases*, mind you, each containing not one, but a number of eggs!

HOW THEY COUNTED 5,000,000,000 HOPPERS .

"Did they count them?" Oh, of course not — one by one. They weighed them. If so many locusts make one pound, then in so many tons there would be so many million locusts. You know.

“So many locusts make one pound.” Sounds as if we were talking of a meat-market or something, doesn’t it? And, sure enough, locusts are eaten in the Far East, where they are so common, and in Africa — baked, ground into flour, and made into a kind of bread; or just plain baked.



GRASSHOPPER LAYING EGGS

Locusts were among the things which, according to the laws of Moses, the children of Israel were permitted to eat.

Ye may eat of every flying, creeping thing that goeth upon all fours, which have legs above their feet, to leap withal upon the earth; the locust after his kind and the bald locust after his kind and the beetle after his kind and the grasshopper after his kind.

And you know that John, the Mighty Voice crying in the Wilderness, had for his meat (*i. e.*, his food) locusts and

wild honey. The "beetle" referred to is probably what we call a cricket; for he "has legs above his feet to leap withal upon the earth," and he is a cousin of the grasshopper folks.

THAT FUNNY MOUTH OF THEIRS

Speaking of grasshoppers eating, hasn't a grasshopper a funny mouth? It seems to open the wrong way — right and left instead of up and down. But, when he works it, doesn't it remind you somewhat of a rabbit's mouth; when the hopper is nibbling a grass blade, say, or "spitting molasses"? Look for his teeth and you will find he hasn't any, but his lower jaws are toothed on the edges, something like the bill of a goose. His upper lip is best seen from in front. Behind it are the jaws (best seen from the side).

The things at the side of the mouth take the place of fingers in poking food into it. These fingers the grasshopper finds useful, also, in making its toilet. To clean its feelers it passes its forearm over its head, crooking the elbow about the end of the feeler nearest to the face, and drawing it within reach of the mouth fingers, and then pulling it through the mouth. As the feelers are being drawn back into place, the grasshopper steps on them. This seems a queer thing to do until you know that the hopper has pads on his feet, for sticking to places, as a fly does, and these pads wipe the feelers, after this mouth washing, as you draw a freshly washed knife through a towel.

His neck and the under side of his body the hopper washes much as a cat washes its breast and stomach, its head bent down under its body.

"What about the molasses?" did you say; "What is it for?" Oh, yes, I meant to speak of that. It's for people who don't like molasses — at least that kind. It gets smeared on the feelers of insect enemies who attack Mr. Hopper. It's sticky and smells badly, and while they are getting it off Mr. Hopper gets away — that is, if everything works out right, from Mr. Hopper's standpoint.

II. IN AUNT FORMICA'S PANTRY

There is this much to be said as to the truth of the old fable about the ant and the grasshopper: the ants *are* thrifty housekeepers, while you could hardly call the grasshoppers housekeepers at all — they're that shiftless!

Take, for instance, the way in which the ants put up condensed milk — the honey-dew milk they get from their little green cows, the plant-lice, and other cows that give such milk. We can see how they do it by going to the right places in Aunt Formica's pantry;¹ to the Garden of the Gods in Colorado, for one. There we find a branch of the ant family that not only condenses this honey milk, but puts it up in round cans or pots with six legs that are kept hanging in clusters from the ceiling. The workers pour the "milk" into these pots, much as the bees pour or squeeze honey out of their honey crops into the wax cells. Then, when the ants want food for the babies, they climb up on the ceiling and take it from the mouths of the cans.

¹ I say "Aunt Formica" because Formica is the scientific name for the whole ant family, and it's the pantries of several branches of the family we are now supposed to be visiting.

You could never mistake the milk in these cans for any other brand, because they all have a special design on them — a dark background with a big white figure on it that always reminds me of the cross of St. George in the British flag called the “Union Jack.” The “trade-mark” really *is* a business affair; for the cans I am speaking of are living ants whose business it is to act as containers for the rest of the household and to keep themselves hung up by their six legs from the ceiling.

CONSUMING THE MILK, CAN AND ALL

Some people drink or, rather, eat this milk, can and all, and consider it a great delicacy, to be served at wedding-feasts and on other special occasions. The people who do this, the Mexicans and the Indians of the mountain regions of the Southwest, knew about these ants long before the science people did. Something like a hundred years ago a Spanish gentleman, living near the village of Dolores, in Mexico, sent to a scholarly friend in Spain — a Doctor Pablo de Something (I forget his last name) some “ants stuffed with honey” (as he expressed it in the accompanying letter) which he said had been served at a wedding-feast where he had been a guest.

Whether he thought the ants had been stuffed by the Mexicans themselves, as dates or olives are stuffed, I don’t know; but I’m quite sure he never dreamed that the stuffing was done by the ants themselves. It was an American naturalist, Reverend Doctor McCook, whose name now ranks with the most distinguished students of the lives of the Little People, who first investigated the honey-pot ants and found out their curious habits. And because the spe-



Copyrighted by Harper & Bros.

HERD OF APHIDS BROUGHT UP BY ANTS FOR SPRING AIRING
AND MILKING

cies he studied made their homes in the Garden of the Gods, he gave them a place in the great Insect Hall of Fame under the magnificent title of *Myrmecocystus hortus-deorum*; that is to say, "Ant-pots of the Garden of the Gods."

HOW THE JARS GROW AS THEY ARE FILLED

These condensed-milk cans, unlike the ones we buy at the grocery, grow in size as they are filled. The abdomens of the ants swell out like fairy balloons, and the pale, thin skin between the dark, hard, and unyielding body rings stretches into the queer pattern I have already spoken of. Why it should be such a reproduction of the bars in the British Union Jack I haven't an idea. It doesn't seem so surprising in a genus of these same ants in Australia and in Africa, but it is hard to understand the design on a Colorado ant, born and raised under the Stars and Stripes!

Anyhow, it's a remarkably ingenious idea, this of a living milk-can that hangs by its own legs up on the ceiling, where it's out of the way of hurrying feet, and that opens its own mouth to receive the honey-dew milk from the milkmaids, and hands it out to the nurses. Don't you think so?

And it's worked out, this idea is, by the ant people, in still another way. They have pots that actually walk on their six legs to wherever you are; come and serve you (if you're an ant) as a waiter serves your order in a restaurant; or as the water peddlers in Egypt fill your drinking vessel out of their big leather bottles. The dairying end of this part of ant life is a business in itself, just as it is with us, and these walking pots — or milk-cans, if you like — attend to it while the other ladies in the family attend to other household matters, such as washing and feeding the babies, taking them out airing, putting them to bed. These "repletes," as they are called — "replete" being a big word meaning "full" — keep milking the cows and swallowing the honey dew until they swell out and show the

trade-mark, as do the honey-pots that we saw hanging from the ceiling out there in the Garden of the Gods. You'll see these walking pots coming in long columns down the trunks of trees. They've been up among the little



Copyrighted by Harper & Bros.

HONEY ANTS ON ROOF OF CHAMBER

green cows, which, gathered in herds on the tender twigs or the opening buds of an apple-tree, say, are sucking its juices with their beaks.

HOW THE HOUSEMAIDS ASK FOR FOOD

The ant home is, let us suppose, a hundred feet away from the foot of the tree. Around the holes that lead into

the underground chambers and galleries the inside workers — the builders and the nurses — are gathered. They meet the dairymaids and ask for a drink. They ask much as a little dog does when begging, standing on their hind legs with their fore legs outstretched and their heads raised. The dairymaids take the same position, and, putting their little mouths against those of the housemaids, the honey is passed, drop by drop, from one to the other. Sometimes two or three will be fed at once in this way — a kind of loving-cup affair.

The housemaids always make it a point, you'll see, to meet the repletes at the door to get what food they want. If they don't they probably won't get any. The repletes will hurry inside and give it to the babies — after the mother queen has been fed, of course. (You know how ants are about spoiling children!)

EATING LIVE TIGER MEAT!

But while honey is the staple diet of many species of ants, they have a great variety of food, including ant "rice," the seed of a certain plant, which they gather and store, mushrooms which they raise in specially prepared beds, and meat of various kinds, including not only insects but live lions, tigers, gorillas, and such. Before the driver-ants of Africa these terrible creatures of the jungle flee in a panic and plunge into the first water they can reach, in order to drown their tormentors. What else can you do? Although you *are* a lion or a tiger, you can only bite here and there in the places you can reach, and if you're a gorilla you can scratch; but what does *that* amount to when these fierce

little creatures have their jaws sunk into your flesh in a thousand places at once?

III. THE ANTS AND THEIR SUMMER BOARDERS

Not only are the ants natural-born housekeepers, but they just love to entertain company. There are more than



Copyrighted by Harper & Bros.

WORKER DRAWING RATIONS

1,500 guests in an ant-house — 1,500 different *kinds*, I mean. Goodness knows how many in numbers! One of these guests is that little ant that lives in a private suite in the larger ants' apartments, and that won't allow its hosts to come into its rooms — the saucy thing! Think of call-

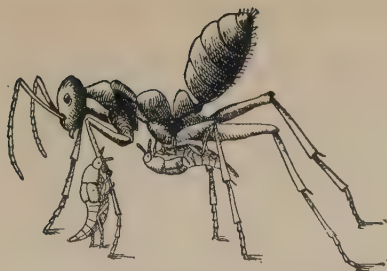
ing on guests in your own house, guests that you had provided with nice rooms; guests you had received, not only for a week-end but for no end of week-ends — for all summer, in fact — and then have them not merely show you the door but take you by the nose, by one of your antennæ, and lead you out!

To put up with a thing like that takes self-restraint; and self-restraint, when other people are *so* provoking, is the very essence of good breeding.

And yet — would you believe it? — these ungrateful visitors never even help with the marketing, never go out to get a thing, but wait for the ladies of the house to bring it to them. Whenever their hosts return from the milking, along come these little guests and get all the honeydew milk they want, the dairymaids giving it to them drop by drop, from their own mouths. Oh, yes, they're very nice to their kind hosts, these saucy little guests are, when they want honey, stroking them with their feelers, licking their faces, and all!

Other guests in the ant households have wheedling ways also. One lodger, an insect with a queer name which I've forgotten, not only strokes the backs of its hosts with its feelers, as the beetle boarders do, but strokes their cheeks with its fore feet, just as the ants do to one another. This particular boarder isn't satisfied with *one* ant family to board with — to *live* on, I call it! In the spring it stops with one kind of ant and leaves its babies for the ant to raise, and then, in the summer, goes to the home of another kind of ant, and stays there all winter!

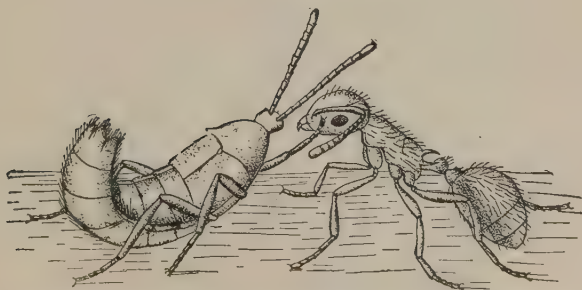
The stroking with the feelers or with the fore feet seems to have the same effect on ants that is produced when you



"Boarder" soliciting food from worker ant.



The beetle the ants make a pet of.



Beetle in Algerian desert that shampoos and massages its ant host.

From "Ants, Their Structure, Development and Behavior," by W. M. Wheeler. Copyrighted by the Columbia University Press

A BEETLE THAT PAYS BOARD

smooth a cat or scratch a pig's back or pat a dog's head. One of the guest people — a beetle — who is a great hand for stroking ants, seems to get the idea sometimes that *he's* a dog himself. It's the funniest thing! I'll tell you what he does.

MAKING A PET OF A BOARDER

When he wants to be fed he raises the front of his body and his fore legs, for all the world like a little dog begging, as I said just a while ago about the ant workers asking for their rations. A passing ant strokes him, and then he begins waving those fore legs. That's his way of barking — don't you suppose? Then the ant begins playing with him and petting him and carrying him about the nest. Then, while licking his face, as a cat licks the face of her kitten, she holds him straight up, brings a drop of honey from her crop and drops it in his mouth. Mr. Beetle — he's a little red chub of a thing — works his jaws and swallows it. Then the ant begins licking his face again, as if to wash it, but this is supposed to be merely her way of expressing affection. Then another drop, more petting, and finally she puts him down and goes on with her housework. The beetle, to be sure, pays a little board by redding things up — eating fragments of food scattered around on the floor — but the ants don't seem to care for this. They love to pet and feed him, so that they'll often pull him away from this scattered food and play with him and give him honey instead.

ROLLS HIM LIKE A BARREL

One of the funniest things about it all — it would make you laugh — is that, as the little beetle with his hard,

smooth shell is difficult to handle, an ant will often try to pick him up, and her jaws will keep slipping and slipping. Then finally she'll give it up and roll him along with her fore feet, as a porter rolls a barrel, the beetle pulling up its legs, the way beetles do when they are playing 'possum. You've seen them.

A BOARDER WHO EATS WITH A SPOON

'Then there's another beetle boarder that the ants feed with a spoon. The beetle furnishes the spoon. Its tongue, unlike that of other beetles, is shaped like a little scoop, and in this it receives the food from the ant's crop.

Of all the guests in Aunt Formica's boarding-house, beetles seem to be the favorites, and most of them belong to species not found anywhere else. Springtails and bristle-tails are also regular lodgers. The bristletails don't seem to be very well liked; and no wonder! For do you know what they do? They hang around until they see one worker passing a drop of honey to another, and then, getting right under where their mouths are meeting, steal it and make off! But a large majority of the boarders are petted by the whole ant household. Now, you may think I've been joking about all this, so I'll just quote you what Doctor Wheeler says:

It is thought the ants, so strong is their love of their own young, keep these guests just as we do pets.

BUT WHAT DO YOU SAY TO THIS?

Of the babies of some of the guests the ants are so fond that they not only take all the care of them — feeding

them and washing them and carrying them about — but if danger threatens the nest they carry these babies to a place of safety before looking after their own. Neglecting their own flesh and blood for the children of strangers!

I don't know what *you* think, but *I* say this is carrying it too far!

HIDE AND SEEK IN THE OPEN

(STRANGE AND CURIOUS THINGS TO BE SEEN IN THE LAND OF THE SIX-LEGGED IN JUNE. CONSULT INDEX ALSO, UNDER "MONTH BY MONTH")

Some fleshy and famous English wit — I think it was Sydney Smith — once exclaimed on a sticky day in June:

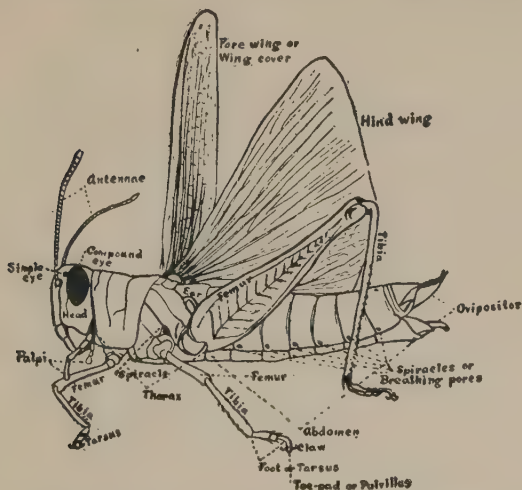
"Oh, how I wish I could get out of my flesh and sit in my bones!"

Now, a grasshopper never wishes anything of the kind, I'm sure; for, like other insects, his "bones" are on the outside of him already! He is covered by a shell made of a substance called "chitin." This chitin shell is his skeleton. All his flesh is inside of it and his muscles are attached to it. As various kinds of grasshoppers are quite numerous by late June, you can learn this and several other interesting things about them. For one thing, you'll notice that Sir Grasshopper's coat of mail is made in sections, united by flexible bands similar to the jointed mail of the knights.

Observe also that on each side of his body are a number of openings, small pits; these are his breathing pores. They connect with a system of air-tubes branching throughout the body. Your blood gets its "breath," its supply of oxygen, by passing through the lungs, but the insect peoples haven't so many parts to their machinery of life as we have, and so are obliged to do things by more simple and direct methods. They breathe through their coats of mail, and, as in case of the grasshopper, they usually have little openings along each side of the body.

You never need tell a young grasshopper not to breathe through its mouth, as young people have to be taught not to do sometimes. Like other insects, he has no breathing pores in his head, although he does have them even along the veins of his wings. (Look at them with your hand lens.)

Observe that as he breathes his abdomen expands and contracts much as yours does. By muscular exertion the air is expelled, and the flexibility of the body wall, due to the plated-mail system, causes it to expand and suck in the air. So, after all, he breathes



Courtesy of the American Museum of Natural History

GRASSHOPPER'S ANATOMY WITH PARTS NAMED

much as you do — although he has *several* breathing mouths instead of one, and none of them are in his head.

And you can see how a young grasshopper puts on his coat of mail; assumes his knighthood, as it were. He does this in some hiding-place. Then he eats and grows until this first coat is too small and he changes it for a larger one. • That is to say, he moults again.

Maybe it's because they *are* always "sitting in their bones" that grasshoppers, like other insects that frequent the sun, are so fond of it. Mrs. Morley tells in her "Grasshopper Land" how she put one on the window-sill that had been kept in the house several days during a cold storm. It laid on its side and stretched its legs like a cat, and basked for an hour or more.

Hold the expanded wing of a grasshopper to the light. You will see it has a network of stiff veins running through the more delicate membranes. These act as a framework for the wings. Raise the outer wings, the wing-cases, sidewise. If done carefully they will stay in place at right angles to the body. Why, do you suppose? After what I have just said, you ought to be able to guess. (For answer, see July department.)

The inner wings are often very gay. Mr. Grasshopper Brown, for example, carries a suit of crimson and gold under his outer, sober cloak, and when he is at rest he is hard to find. That's *his* Halloween trick!

Did you ever read Mark Twain's funny story about "The Jumping Frog of Calveras County"? Well, anyhow, as you can imagine from the title this frog was a great jumper. Yet a grasshopper could have beaten him. Notice that the long, jumping legs of the grasshopper are fastened near the middle of his body, while the frog's are at the rear. Of course, I'd choose the same kind of leg attachment that the frog has — if I were a frog; but then again I'd choose the grasshopper style if I were a grasshopper! You see, the frog's legs are put right where they work best for jumping forward, plunk into the pond, for example; but the grasshopper wants to jump up as well as forward, so that he can get above the grass and weeds in which he spends so many of his business hours — he being a *grass* hopper.

A grasshopper's legs are, fundamentally, like ours, but much more slender and relatively stronger. They also have, you'll notice, a double joint at the hip, just as your legs have, and for the same reason; this double joint gives great freedom of motion.

When he goes to jump, a grasshopper draws the tibia (the lower part of his leg) much closer to the femur (the upper part) than we can do. For a big jump, notice that he squats very low; that is to say, he gets these parts of his leg as close together as ever he can.

He finds it a great help in his hopping and jumping business to have those two little spikes at the end of the tibia. (See them?) They serve the purpose of the hobnails in our hiking shoes. At the moment of jumping, notice how he presses these hobnailed feet of his against the ground.

Did you ever see a grasshopper trying to make its way over glass, how its feet keep sliding without making any headway, like the wheels of a locomotive on a slippery track? That's because those

hobnails are no good for walking on glass. But look for species of grasshoppers that have little flat disks between their foot hooks. These grasshoppers can not only walk on smooth surfaces, but can walk upside down like a fly. The small brown grasshoppers of the meadows have these pads. Put one in a glass fruit-jar, and you can not only see him walk up the sides, but you can see his "rubber shoes."

These shoes work on the principle of the boy's plaything called a "sucker." Thoroughly soaked in water and then pressed against the pavement, you try to pull it loose and you can't, because there's a pressure of fifteen pounds of air to the square inch. When the fly or the grasshopper sets his foot down, he squeezes out the air from under it; then, when he wants to move, he has the power of raising up one edge of the sucker which lets in the air, and he's free to move that foot while holding on with the others; or he can release all his feet at once.

Observe how a grasshopper climbs a weed, "hand over hand," like a man climbing a ladder; and how he slips around on the other side of a grass stem, as a woodpecker or a squirrel does on a tree, and for the same reason — so you won't be so apt to notice him, and he can still keep an eye on *you*!

Now compare the June-bug's legs with the grasshopper's legs. They are made, not for running on the surface of the ground, but for crawling while he is underneath the ground in the early part of his career. He also has strong jaws for biting the roots on which he lives during his underground life.

For two or three years he leads this mole-like existence. Then he makes a little chamber, there changes his clothes, comes out and introduces himself as Mr. June-bug, by bumping into your face some evening. You'd never suppose, to look at him, that he was the very same chap that, as a fat white grub with others of his kind, had been spreading devastation in your garden by eating off the roots of things. These grubs also do great damage to very young fruit-trees and to fields of wheat. Sometimes there are millions of them in the soil. In newly ploughed soil crows eat them eagerly. In infested districts the grubs are ploughed out in the spring and gathered and buried with lime, thus making an excellent fertilizer.

The round-headed apple-tree borer is another member of the beetle tribe who is "born from one to four years old," depending on climatic conditions. Look for spots of sawdust on the trunks of

your trees, especially after a rain, use your knife and wire as previously explained (p. 40), and you'll find the boring larvæ that are doing the work. The beetles that lay the eggs from which the larvæ hatch begin their operations about dusk of June and July evenings. They are about three-quarters of an inch long and are pale brown, with two broad creamy-white stripes running along the length of their bodies.

Tumblebugs are such comical things to watch! Don't you think so? You can see plenty of them in June and July. When I was more of a boy, if anything, than I am now — that is to say, when I was younger — the tumblebugs always seemed to me to be the clowns of the great circus of Insect Land. Did you ever notice, for instance, how cheerfully a tumblebug takes his tumbles, as if he really did it on purpose and just for the amusement of the spectators? And how, where two are rolling a ball together, one of them, after a tumble, will sit tight with his legs gathered under him and let the ball roll over him? When two are rolling a ball together they go up heights one couldn't manage alone, one of them pulling and the other pushing. This looks like a very nice partnership, but Fabre says one of the tumblebugs is always watching his chance to steal the ball from the other, the rightful owner who made it; he's a robber and not a partner at all!

And here's something Fabre did that you'll be doing, I'll warrant you. To try Mr. Tumblebug's engineering skill in a new field, as he then supposed, he fastened a ball to the ground with a pin. When Tumblebug found it wouldn't budge, he walked around it inquiringly, two or three times, as much as to say:

"Well, *that's* funny!"

Then he pushed some more. Then he climbed up on the "roof" and looked around and came down, "the opening and shutting of the fans of his antennæ showing," says Fabre, "the puzzled state of his mind." (A way of scratching his head over the problem, perhaps.) Then Beetle No. 2 (this was one of those "partnership" affairs), who had remained squatting on top of the ball, came down, and both explored.

When you try this, select a ball that has only one beetle moving it. Then we may find another case where two heads are better than one; that in Beetledom, as among human beings and ants, and so on, there is an intellectual stimulus in companionship. For just listen to what happened next: Digging down, one of Fabre's

two beetles discovered the pin. Then both beetles got under the ball from opposite sides, and by pushing raised it to the height of the thickness of their bodies. Then they rose gradually to their feet, like an expressman lifting a heavy trunk with his back. Then, standing on their fore legs and pushing with their hind feet, and vice versa, they finally pushed the ball off the pin, repaired the hole, and resumed their journey.¹ All of which seems to show that the tumblebugs *have* invention to meet new situations; but just as we get to thinking that, Fabre tells us further investigation showed that the ball frequently gets fixed on stubble and broken stems of grass and that the beetle deals with the problem in the same way.

In June the tree-crickets, as well as the ladybirds and other larvæ, will be found wandering over the tree branches searching for aphids, and many species of aphids are migrating from the trees to plants, as explained on p. 44.

Katydids will be found on various plants, often on the wild rose, the petals of which they eat.

Have I said anything in this book so far about the treehoppers? I don't think so. They are very curious creatures, and they make it a point to be around about this time of year — hatching in late May or early June. But in order to find them, it isn't enough to *look* for them or even to *see* them. You must *know* them when you see them; otherwise you'll think you're looking at a thorn! Look for them on the sappy parts of various trees and shrubs, that is to say, the smaller branches. The hoppers belong to the bug family and suck the sap with their beaks. They never sit across the twig, but always in the direction of its length, and with the projecting part of their bodies always turned toward the end of the branch — just as a real thorn does.

Look out also for Miss Moving Blossom, in her pink-silk dress. She's a bug also, and with her beak punctures the seed-pods of the little rushes that grow along pathways, but she looks like a tiny tube-like pink blossom. This blossom is the silken case of the larvæ of a moth.

Eggs of both black and tree crickets hatch in late May and early June.

¹ Whether both beetles stand on their heads and use their hind feet at the same time, or whether one uses his front legs while the other uses his hind legs, as in rolling the ball, Fabre doesn't say. This will bear looking into.

And moths and butterflies — plenty of them in June! Painted Beauties are laying eggs on the everlasting. Tiger Swallowtails come from their winter houses, sip nectar from clover and other flowers, and lay their eggs on birch, wild-cherry, sassafras, poplar, and other trees. Other late risers are the Violet Tip and Red Admiral Butterflies, whom you might expect to be up long ago, as they winter with their wings on, but only in June, as a rule, are they to be seen, flying over the fields and along the highways. Cecropia, Luna, Prometheus, and Polyphemus Moths are now to be seen also. Humming-bird Moths are flying in the sun visiting blossoms. One of the best places to watch for them is on the iris.

In swampy places look for the Baltimore or Phaeton Butterfly. The interesting story of the Baltimore Butterfly has just been added to the wonderful life-history groups at the American Museum in New York.

Many butterflies have the habit of dropping suddenly, after a short flight, and resting on the ground, lying over on one side. This not only throws the protective coloring of the under side of the wings into prominence, but hides their shadows. The Grayling Butterfly does this, as much as to say: "You shan't see me or my *shadow* either!" It's the cutest thing!

Answers

THE MERRY MONARCHS AND THE BREEZE

By June large companies of the migrating Monarchs may be seen, "up from the South at break of day," although they begin coming as early as late April. You can also see them answer the question I asked in September as to whether in rising they face toward or away from the wind. You'll notice that they always face it, for the same reason that a bird or a bird-man or a boy flying a kite does the same thing; the wind thus helps the butterfly, the bird, the flying-machine, and the kite to rise.

The Monarchs are particularly fond of the wind. Miss Dickerson, in her book on "Moths and Butterflies," says she has seen them in the mountains of New Hampshire sporting about the tops of the tall pines, while a stiff breeze was blowing. "Now it spreads its sails to the breeze and is hurried violently backward and upward. Again, slowly descending and advancing, it describes a variety of charming curves, waves, and undulations. It even sports in the

same way during a light fall of rain." Perhaps the Monarchs are so fond of the winds because they depend on them for travelling. When migrating, although they face the wind in rising, once having risen they face away from it and are carried by it.

Notice how a Monarch smells a flower. It constantly turns its feelers forward, sometimes one at a time, sometimes both together, as if it enjoyed the perfume immensely.

The Viceroy, as if they knew they could now depend on the protection of big brother Monarch (as illustrated on pp. 31 and 33), emerge from their winter chrysalides in June, about the time the Monarchs arrive from the South, and may be seen flying over fields and along roadsides.

THE BIRTHDAY DOOR OF THE GRASSHOPPERS

The mother grasshopper, in laying her eggs, arranges them around the edges of the hole and leaves an open space in the centre, so that the baby grasshoppers can have a convenient passage-way in coming out. As a result, there can be no possible disputes as to who is really the first-born, as there is among the bramble-bees. (See p. 144.)

June is a good time to look into this, for the red-legged locusts, among others, will be coming out toward the end of the month. Grasshoppers are not early risers in the spring, and don't stir with the first spring warmth, as so many insects do. They seem to say: "Breakfast isn't ready — no green things yet to speak of — what's the use?"



Copyrighted by Harper & Bros.

BOMBARDIER BEETLE FIRING AT AN ENEMY

CHAPTER XI

(JULY)

THE CANNING SEASON IN LILLIPUTLAND

“Whew! How hot!”

That’s what I’d say, and then I’d go into the shade and rest if *I* were Mrs. Wasp. But, no, sir!

“Stop and rest,” says she, “with the markets just full of the nicest, fattest, and tenderest caterpillars in the world, and so much canning to be done! The bee people, too, how are they going to stop right in the best part of the year, with the fruit to be put up and the bread to be made, and all?”

“And, in addition to what we do for ourselves — we housekeepers of the insect world — we do a lot for you. The bees not only furnish you with honey, but they help

the wasps help make your apple sauce and your plum butter, and such.

"Stop in the shade and rest? I'd like to see you!"

I. HOW CERTAIN LILLIPUT LADIES GO TO MARKET

I couldn't make out at first what Mrs. Wasp meant about the apple sauce and plum butter, could you? Of course, the bees help in a way — yes, in a very important way, too, when you come to think of it; for we couldn't make apple sauce or plum butter without apples or plums. Could we? And the bees certainly do help grow them by carrying the pollen from one flower to another — we all know that. But the wasps — what have they got to do with it? Ah, I think I have it! Remember what Mrs. Wasp said about the nice fat caterpillars? The wasps eat caterpillars that would otherwise eat fruit. That's it! One apple-worm carried off to a wasp "cannery" means one apple saved; and when I tell you that as many as two dozen caterpillars have been found packed in the house of a bramble wasp in a blackberry stem, you can see that the wasps are very important little people to have around an orchard.

To be sure, Mrs. Wasp does bite into a nice ripe apple or a peach or a plum now and then, for a sip of the juice, although most of the time she lives on the nectar of flowers. But, pshaw, what does that amount to? Doesn't she deserve it? You really don't know how tiresome shopping is until you've been out for a few hours with Mrs. Wasp. Let's go into the garden with her now — for she's just as busy in the garden as she is in the orchard.

IN THE MEAT-MARKET WITH MRS. WASP

There she goes, flitting and running along the ground, looking under the leaves — running three or four more steps, then flitting again and jumping up into the air an inch or so. You've often seen wasps do this before, haven't you, but did you know what they were up to? They were looking for caterpillars, just as Mrs. Wasp is doing now.

She keeps up the hunt until finally out she comes from under a leaf with a green caterpillar. The sting which she administers puts it to sleep so that it does not struggle. Seizing it in her jaws, she drags it on its back head first with her legs on either side of it. Part of the time she backs up with it, part of the time she walks forward. Most of the time she pulls it along on its back, as if it were one of those packages marked "This side up, with care." Do you suppose this is to keep its feet from dragging and so make it easier to haul?

But if we don't want to lose sight of her I'll have to stop talking so much and we'll both need to step lively. There she goes, zigzagging across the bean patch! Reminds me of a man moving a heavy trunk by turning it first on one corner and then on the other.

Here I'm philosophizing again and we've lost her! Where is she?

Over there? Yes, I see her now, and here we go into a field of standing corn. Good thing it isn't any higher! Dodging here, there, and everywhere among the stalks, we finally see her reach the front door of her little nest in the ground, where she'll pack the caterpillar away for one of her babies — first laying in its body the egg out of which the baby is to come.



Copyrighted by Harper & Bros.

WASPS BRINGING AND BURYING CATERPILLARS

DIFFERENT IDEAS ABOUT BABY-FOOD

She must have just the kind of meat she wants or she won't take it. So, although this is the very height of the caterpillar season, she may sometimes have to hunt hour after hour without getting just the kind she wants. Different kinds of wasps specialize on different kinds of caterpillars. You will often see one going up and down, up and down, stem after stem among the beans, looking under every leaf. This means she's after the caterpillars that are after the beans.

And it's just as well that they do have different tastes in these matters, for, goodness knows, they quarrel often enough as it is!

Wasps, even the same species, have dispositions, characters, particular ways of doing things — or letting them go undone — just as human housekeepers do. No doubt about it! For instance, in marketing, some of them are like boys and girls who've been sent to the grocery to get something — often in a hurry — and they stop and look in at every shop-window that takes their fancy. On their way to the meat-market these happy-go-lucky wasps will turn aside to take a sip of nectar from every likely-looking flower they come to, while the more serious-minded, who know that housekeeping is an exacting business, and to be closely attended to, will keep their eyes and their "noses" strictly on the search for caterpillars — or flies, or whatever — and pay no attention to anything else.

Different species have different ideas also about getting the things back from market. Some ship by slow freight, as it were, dragging the meat along the ground, while

others ship by aeroplane; that is to say, they carry the captured caterpillar through the air.

“FOX-HUNTING” AMONG THE WASPS

A curious thing about certain kinds of fly-catching wasps is that they start on the hunt together, like men on a fox-hunt. They live in colonies, each in her own home, you understand, but they are neighbors. At one minute everybody will be at home, each busy with her own affairs, digging a nest, storing meat, dashing at some other wasp that she happens to be at outs with. Then suddenly away they'll go, troop after troop, and the place will be deserted; nobody left except a lot of flies of a certain sort that keep up a wild kind of waltzing in the air above the wasp village. And let me tell you something about these flies; *they've no business* there. They're the reason the Mrs. Wasps — or most of them — keep their front doors locked when they're away. And as they can't hide the key, they hide the door, as we saw in Chapter VIII.

HIGHWAY ROBBERY IN WASPVILLE!

Besides sneak-thieves — I have just given a pretty broad hint as to whom I mean, haven't I? — there are *highway robbers* in Waspville.

And I am sorry to say these robbers are wasps — citizens of the village! Partly from hard luck — and partly from carelessness, no doubt — a great many of the wasps come back from market without a thing, and they try to rob the more fortunate and the more industrious.

A Mrs. Wasp comes home with a fly, say; one of those spindle flies that lay eggs in apples, maybe. Well she can't

hold her market things with one hand and open the door with the other, as you and I can. She must lay down her meat and scratch away the earth at the entrance to the nest. Then the robber falls on the provisions, and Mrs. Wasp turning round — if she turns in time — falls on the robber, and they have it out. Mr. and Mrs. Peckham, to whose loving study of these curious little people we owe so much of our knowledge of them, says the rightful owner usually wins.

“Thrice is she armed who hath her quarrel just.”

So Mr. Shakespeare says — or almost says; and probably it's as true among wasps as it is among human beings.

II. THE BEE JELLY-JARS AND THE LITTLE “STOVES” THAT MAKE THE JELLY “JELL”

While the wasps may be said to “can” the meats they pack away for their babies, the important people in the *fruit-canning* business in Lilliputland, as we all know, are the bees. The making of their jelly-jars alone, the honey-comb cells, is one of the most remarkable things in the lives of these remarkable little people.

When they start this part of the work, you might think they were going to give a circus. Two bees climb up to the top of their upside-down city, and, taking positions some distance apart, they cling to the roof with their fore feet. Then two more bees cling with *their* fore feet to the hind feet of the first two, and so on, until two strings of bees, like daisy chains, are hanging down.

Next, the two chains swing toward each other until the two bees at the lower end can hook their hind feet, so form-



Copyrighted by Harper & Bros.

WASP TRIMMING OFF WINGS OF FLY

(See p. 280.)

ing a kind of festoon. Several of these festoons are made, and the bees, in these intertwining masses, in some way heat up their bodies.¹ The air gets so hot you'd think that

¹ "By a strong internal exertion," says Professor Kellogg, head of the Department of Entomology at Leland Stanford University.

Beetown was on fire! But this heating up of the "works" is evidently necessary to the wax-making process. The wax-makers keep themselves hung up for from sixteen to twenty-four hours, during which little scales of wax appear at the openings of four pockets underneath their abdomens.

After the wax is made the "festoons" take themselves apart and the wax-makers approach the waiting artists who are to fashion it into the jelly-jars, as much as to say:

"Here's your wax!"

According to some observers the scales, after being made, fall off. Others say they are plucked off by the manufacturers; others by helpers who take the wax to the makers of the jars. So it would seem that the matter is handled in all of these ways but not always in the same way. Maeterlinck even tells of a chief architect — a Sir Christopher Wren — or more likely a "Jenny" Wren, for all the workers are females — who seems to start the building:

Now, a small block of wax, formless as yet, hangs down from the vault. As soon as it is thick enough, a bee emerges from the mass. Her manner displays such settled conviction, her movements are followed so eagerly by the crowd, that one might almost fancy that some illustrious architect had been summoned to trace in the void the first cell of all, from which every other must mathematically depend. She scoops into the block and lays the wax she removes on the border of the cavity. . . . Then, with a final lick of her tongue and a final wave of the antennæ, she goes as suddenly as she came and disappears in the crowd.

The wax scales are chewed and come through the mandibles as thin strips. These strips are then mixed with

saliva, and the mandibles are used as trowels to knead the wax and bend, flatten, roll, and straighten it into cells.

THE THRIFTINESS OF THE CAN-MAKERS

“Be very careful of your wax, sisters. Remember that wax costs honey!”

That’s the caution that passes along, somehow, in Beetown in the canning season; for the little housekeepers are as careful and saving about this part of their work as if they had studied domestic economy in the best schools in the country. And no wonder! Do you know what a pound of wax costs — costs a bee, I mean? Sixteen to twenty pounds of honey! That is to say, it takes that much honey to make a pound of wax. Before they start to make wax, the bees that have been “assigned” to or have chosen that part of the job, fill themselves with honey, and this honey, in some mysterious way not understood, changes into wax. It is to make the wax go as far as possible that they use the shape of cells which, according to the careful calculations made by mathematicians, gives the largest holding capacity for the expenditure of a given amount of wax. Solitary bees, who evidently haven’t gone so far in mathematics as the social bees, use less economical cans, just as we do.

The bees are also very thrifty about this can-making business in another way. Cells for honey are made of new wax, while for brood-cells old wax or wax mixed with pollen is often used — depending somewhat, apparently, on whether times are prosperous; that is to say, whether or not there are plenty of flowers in the market. And here’s

still another thing. Any combs or parts of combs not needed are torn down and the wax used to build new cells or for caps for cells already made.

Yes, and did you ever stop to think why the outer edge of the cells is thickened into a kind of rim? It's because otherwise the continual tramping of thousands of busy little feet would wear them down. The bodies of the cells, on the other hand, are made much thinner because, packed together as they are, they support each other.

WHAT AN ORIGINAL IDEA IN CAN-COVERS!

But here's the most original idea in can-covers I ever heard of, and a trick worth knowing — if you happen to be a bee. The honey is kept from running out of the cells until the caps are put on, partly by capillary attraction, partly by the fact that the cells are tipped up a little, and partly by the "cooling down" of the honey, which, being thus made thicker, doesn't run so easily. Yet, in spite of all this, the honey would get too thin and run out in hot weather if it wasn't for a special cap the bees put on these "cans." What do they do but take some honey that has already been "boiled down" in the way I'll tell you of in a moment, and put it on top of the thinner honey, so that it makes a kind of floating cap! Doesn't this remind you of the paraffine caps that housewives put over their fruit nowadays? And it seems to me I've heard of such floating covers being used on milk-pails in the Alps; the kind of pails the milkmaids carry in pairs hung from a yoke across their shoulders.

Anyhow, it's a good idea. Don't you think so?

HOW THE BEE HOUSEKEEPERS MAKE THEIR JELLY "JELL"

We have all learned that jelly is made by boiling down the fruit juice, and that one reason the boiling thickens it is that the heat evaporates the water in the fruit juice. But the bees made their fruit jelly in substantially the same way long before we human beings ever got around to it. They have made their jelly "jell" without gas-ranges and other conveniences the modern housewife has; although I won't say the bees don't have stoves, because they do, in a manner of speaking.

Near the exit and scattered through the hive you'll see a number of bees standing with heads down and bodies tipped up, buzzing away for all they are worth. They are working the ventilating-fans, and, as it were, stirring the fire in the stoves, to make the jelly "jell." This vigorous exercise greatly increases the temperature of their bodies, which in turn heat the surrounding air. Then the fans — their rapidly vibrating wings — make air-currents, which, passing over the honey in the open cells, helps the water to evaporate and so thickens the honey. At the same time the current carries the moisture away and the hive is being ventilated; for fresh air keeps flowing in as the inside air flows out. By putting your hand at the opening of the hives you can feel the current.

HOW THE BEES ADD A PRESERVATIVE

But even this isn't all. You know jelly and fruit, if they aren't put up just right, will spoil. The bees know this, too. To make their jelly keep they add to it a certain acid; and, curiously enough, this acid, that keeps the honey

tasting so good, is the same stuff that makes a bee's sting *feel* so bad — namely, formic acid. The acid is added at the time the bee empties the honey out of her front stomach into the comb-cell or into the front stomach of another bee who attends to the "canning." They work it in both ways. It is thought possibly this acid comes originally from the poison-sacs, but at the time of emptying the honey, it comes from certain glands in the bee's head.

"THIS WAY TO THE BEE FRUIT-STORE"

Everybody knows that flowers advertise to get the bee trade, by the use of color and giving away nectar and perfume, but have you heard that some flowers put up signs pointing toward the nectar, much as an enterprising merchant puts up signs on country roads? Well, so they say! Conspicuous masses or lines of color in flower petals generally come together about the opening that leads to the nectar. The importance of these guides is indicated by the fact that bees have such a strong sense of locality, as you have already seen in connection with their "geography" lessons.

HOW THE WHITE CLOVER KEEPS BOOKS FOR THE BEES

And no wonder the white clover gets so much of the bee trade! Not only is it the very best source of honey, but these wise little flower persons keep books for the bees. Their system of bookkeeping is very much like that used by many housewives, in which little pegs are stuck into holes in a board to show what things need to be bought for the pantry.

The white-clover blossoms, like those of the dandelion,

are made up of numbers of little individual flowers. And if you will examine a white-clover head you will see that the outer flowers are open, while those in the centre are still in bud. A bee, coming from another white-clover blossom, naturally lights on these outer florets first and fertilizes them, which means that they will close over the seed-vessel, and there will be no more nectar there for Miss B. But in order that she may waste no time looking for nectar that isn't there, these florets not only turn brown and wither, but bend down out of the way and tuck themselves tight against the stem! You've often noticed these little white-clover people in the fields, with their florets carefully parted in this way, but probably thought nothing of it. Well, this is what it means!

HIDE AND SEEK IN THE OPEN

(STRANGE AND CURIOUS THINGS IN THE LAND OF THE SIX-LEGGED
TO BE SEEN IN JULY. CONSULT INDEX ALSO, UNDER
"MONTH BY MONTH")

Do you happen to remember who buried Cock Robin? I know who *killed* him, of course — the sparrow with his bow and arrow. But, anyhow, whatever Mother Goose says about it she is mistaken; for I *know* she doesn't say it was the Burying Beetle who buried him, and that's who it must have been.

And — what looks odd — these six-legged undertakers nearly always work in even numbers. There may be two, four, six, or eight together; but thirteen would be an unlucky number for them, and so would any other odd number. Why is this? Try to think, and then look at the "Answers" in the August department.

Meanwhile let's watch them at their work. July, August — all the hot-weather months — are busy times for the burying beetles, but not all species of carrion beetles bury the dead bodies on which they live. All have very keen "noses," however, and the little pits in those enlarged portions of their feelers are, apparently, the source of their unusual sense of smell. Step, an English naturalist,

tells how four burying beetles buried two frogs. Within twelve hours two of the beetles, working together, buried *their* frog, while the other two spent a day running back and forth over theirs — as if taking its measure to see how deep the grave should be! On the third day they buried it by getting under the body, scraping out the earth, and pushing it aside with their hind legs.

In the case of a little dead bird they dragged at the feathers from below. Then one beetle drove the other away, and continued the work alone for five hours, lifting the body, changing its place, turning it, arranging it in the grave. From time to time he would come from the pit, mount the body, then go below and pull at the feathers. At last, as if weary, he came out and leaned his head beside the bird and stood, without the smallest motion, for a full hour. (I think he must have been of an overenergetic type and irritable — for look how he drove his partner away!) Then he crept under it and resumed his digging. The next day the body had been sunk an inch and a half. The funeral director then quit work until evening, and “the trench remained open all day, as if the bird were laid on a bier for public view.” That night it was sunk a half-inch lower, and in another day was completely covered.

I have spoken of the keen sense of smell of these burying beetles. There are also beetles that you can find by your own sense of smell, but the odor is not unpleasant. Gibson tells of his first introduction to these scented beetles in “Eye Spy.” A warm day in mid-July in the woods, with only a gentle breeze stirring, is the best time to find them, for, although they are timid creatures of the night, usually concealing themselves in the cracks and hollows of trees in the daytime, the delight of being in the hot sun they apparently can’t resist. A gentle breeze will bring you the odor, while a stiff breeze would carry it away and scatter it so fast you wouldn’t detect it. The odor is usually described as “musky,” but even to Gibson’s experienced nose it first suggested bananas, then pineapples, and then strawberries; and then, as I remember, something else. Anyhow, he followed his nose, and two or three yards away found a little crowd of beetles, each about an inch long, with purplish-brown coats of mail that glistened like bronze, all gathered around a hole in a maple trunk, sipping the maple-sugar water.

It is very interesting to see longhorn beetles use their wireless-telegraph outfits, those feelers that give them their name, “longhorn.” Bastin tells of an experiment he made with a pair of them. He placed Lady Longhorn in her little private box on a table, and,

some four inches away, Lord Longhorn. My lord seemed wholly unconscious of his lady, being absorbed in some other line of thought, apparently, until she uttered a low, shrill note.

"What was that, my dear? What did you remark?"

That's what he seemed to say in his beetle way; for he immediately extended his antennæ and moved them round and round, as if endeavoring to locate the sound and get her message.

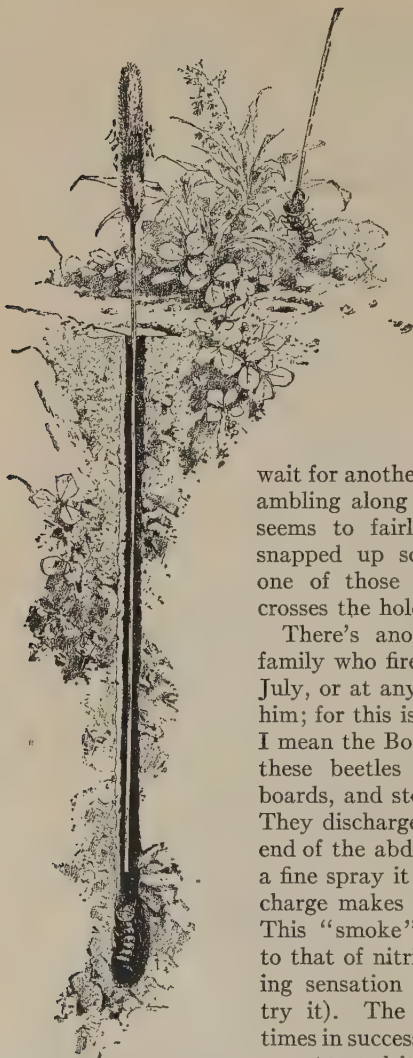
Now (still speaking of beetles) let's pretend it's the Fourth of July. I want to show you a new kind of fireworks. You've read in my "Strange Adventures of a Pebble," perhaps, how the big boulders of our fields sometimes jump up off the ground and then drop down again and sit as quiet and dignified as any other boulder. It's as if they had grown tired of being in the same position for so long — some thousands of years since they came in with the early settlers in the Ice Age — and wanted to shake themselves up a bit!

Well, boulders don't do that very often, but any Fourth of July — or at any time in July, for that matter — you can see pebbles do it; and not one pebble, but hundreds of pebbles! Look along the pathway through the grass there. See those tiny pebbles and pellets of earth popping up from the ground? That's been going on for nearly an hour. And do you know who's popping them up? It's a tiger — a pigmy of the Tiger-Beetle tribe, in the little lair under the ground where he'll wait for his prey after these "fireworks" are over. What we see are the pebbles and pellets of earth he is digging up and throwing out in the making of his hiding-place.

Want to meet this tiger face to face? Then let's send in a card of introduction, and he'll come out and meet us. Not in the best of humor, I'm afraid! But, then, being a tiger, we can't expect too much of him in the way of gentle manners, can we?

The way you send in your card is this: You take a stiff little stem of grass and poke it down into the hole you'll find at the place where this popping up of the dirt and pebbles has been going on. Clinging savagely with his jaws, out will come a little wormlike creature. He's white and soft and has a hump on the lower part of his back. On this hump are two little hooks. He has an enormous head for his size, and it's round and fits his lair like a stopper. With your grass stem — or with your finger if you want to, it won't hurt much — touch his tail. In a flash his body is bent back, and he grasps your finger or your grass stem with his jaws.

It is this turned-back position that he takes in his hole in the ground, so that the under side of his head, where he keeps his jaws,



Copyrighted by Harper & Bros.
TIGER-BEETLE LARVA
IN LAIR

is uppermost, near the top of the hole. With his six legs and those two hooks on the hump on his back he clings to the walls. Then let any unwary insect walk over the little hole through which you'll see two sharp, curved prongs — the tiger's jaws — sticking out about an eighth of an inch, and snap, the insect has disappeared! The tiger will drop with his prey to the bottom of the hole, suck the juices from it, then come up and throw the body out and

wait for another victim. A green caterpillar ambling along toward his next eating-place seems to fairly dive out of sight, he is snapped up so quickly! A big red ant — one of those red warriors, mind you! — crosses the hole. Click! he's gone!

There's another member of the beetle family who fires off a gun on the Fourth of July, or at any time when anybody bothers him; for this is his means of self-defense — I mean the Bombardier Beetle. You'll find these beetles hidden away under sticks, boards, and stones, usually in damp places. They discharge a fluid from a gland at the end of the abdomen. It is shot out in such a fine spray it looks like smoke. The discharge makes a pop like a tiny firecracker! This "smoke" has a pungent odor similar to that of nitric acid and produces a burning sensation on the skin (if you want to try it). The Bombardier can fire twenty times in succession — so it is said, although I never tested it — a regular magazine-gun!

Beetles? Why, you could make up a whole book about beetles, and many grown-up

"boys" have. Your big Boy Scout Dan Beard's "Boy's Book of Bugs, Butterflies, and Beetles" you should by all means get. It tells no end of interesting things about beetles, bugs, and butterflies, and gives you valuable suggestions about collecting and preserving them.

I've said so much in this chapter about wasps and how they can caterpillars, that it seems only fair to pay a little attention to the caterpillars themselves. To begin with, then, did you know caterpillars are near-sighted? Wag your finger several inches away from one's face and he won't notice it. His eyes are for short focus, so that he can see the surface on which he crawls and the food he eats, but that's about all. That's one reason why it's so disconcerting to a bird, I suppose, when a caterpillar makes a face at him — he has almost touched it before the surprise is sprung!

Notice, as I said in October, how popular striped goods are among the caterpillar people. Why is this? When you find one take a good look at it and its surroundings, and then back away and take another look and make a guess. Then look at the "Answers" in the August department and see if you have guessed correctly.

Mrs. McMurry, in her book on nature study, tells of watching a hairy caterpillar taking off its hairs — somehow — and weaving them into its bed-quilt; but whether it pulled them off or bit them off she wasn't sure. Watch and see if you can tell. You'll see how cleverly it weaves these hairs together with the "silk" thread from its mouth, using its head and front legs in doing the weaving. Observe, also, how it makes the top thicker — the thatch of the roof, if you regard the cocoon as its cottage — by turning over on its back to do this part of the weaving.

In the rolled leaves of the sassafras and the spicebush look for the caterpillar known as the "Spicebush Bugaboo"; and on the leaves of carrots, parsnips, and other members of the parsley family, for that other fearsome creature described by Cock Robin and his friends at our Halloween party in October.

Collect some of those big yellow-and-black-striped caterpillars with two "horns" at each end, and watch the birth of the Monarch, as described in the March chapter.

You won't be studying geography in July, but, in connection with the fruit-canning of the bee peoples that we have been talking about in this chapter, July will be a good time to observe how *bees* study geography. You can do it right at the family breakfast-table. Put

some honey on the table, leave the window open, and probably a few bees will come; and perhaps later bring some of their chums to share your hospitality. All before leaving will hover about for a while with their eyes fixed on the honey. This is to fix its exact locality in their minds, so they will know their way back, just as they do when transferred to a new hive or as young bees do when first leaving home for the wide fields and the flowers.

Leaf-cutter bees are common in July, and you can see them cut the leaves and the rose-petals for wall-paper for their little homes, and do all the other fascinating things described in Chapter VIII.

But here's something about bees that you'd probably rather watch through somebody else's eyes, and that is how a bee works her stinger and how the stinger itself goes on working after the bee has left it sticking into you! Before she stings you, if she is in flight, she takes a sort of flying start, like a boy running to jump a brook. This is to make the stinger sink deeper. If you hold still — as a true scientist should! — the bee, after pulling at the sting and finding it won't come out, walks around it in a circle, as if unscrewing it, and this often loosens it and she flies away. If, however, she pulls out her poison bag in the effort, she dies or is maimed.

The bag is covered with muscles which work it, much as you work a squirt-gun. If the bee leaves her stinger, the muscles will go on squeezing the poison-bag for some little time, and also work the stinger farther into the wound.

The mechanics of the bee's sting is almost exactly the same as that used by many insects for boring into wood, but the wood-borers' tools have saws at the end instead of the hooks we find on the bee's stinger.

In watching the baby bees don't forget that baby ants have their special childhood life also. Like the bees, the first work of young ants is to tend their baby sisters. As the skin, the chitin armor, becomes a little toughened, they are pushed out-of-doors, and go to gathering food for the family. By and by they are strong enough to help dig new rooms and hallways in the family mansion.

And now would you like to "listen" to a conversation between ants? It looks like a deaf-and-dumb language, but it isn't. For instance, if meeting an "unfamiliar face" outdoors, one ant wants to say to another, "Do you belong to our nest?" they put the eleventh segments of their feelers together. It is by the sense of smell in their eleventh segments that ants recognize their nest mates.

If they want to know anything about the eggs, larvæ, or cocoons, they use the eighth and ninth segments — at least, it is by these segments that they are guided to them. They recognize the smell of the nest by the twelfth segment, and they retrace their own paths in going to and from the nests by the sense of smell in the tenth.

Perhaps they talk about all these things when they meet and put their feelers together. You've seen them do it lots of times, haven't you? And all you thought about it, perhaps, was: "Oh, it's just a way ants have!" Now, by watching them closely and seeing what they do before and after these apparent "feeler talks," you may learn many things that ant students all over the world would be glad to know. The facts I have mentioned as to the knowledge they get through their feelers have only been discovered in recent years through the careful study made by Miss Fielde, an English observer.

In your artificial ants' nest the building methods of the ants can be easily studied; how the little masons use the trowel, for example. Their mandibles, when closed, form a little trowel, convex in front and above, concave beneath and behind, and pointed at the tip. You wouldn't *want* any better trowel — if you were an ant! It is used for scraping up the soft earth, for moulding it, and for pressing it into place so as to make good, solid walls. These same mandibles that thus form a trowel when closed serve equally well, when opened, for cutting earth and for carrying it from place to place. After the clay has been dug out by the mandibles, the fore legs as well as the trowel are used to scrape it up, to mould it into those little building bricks (the earth pellets you see them carrying) and for patting the bricks down after placing them in position. Some of the pellets the ants dig out in enlarging their quarters they bring outside, and some they keep inside for building partitions.

They don't like to build in soil that is too dry and crumbly. One doesn't want one's house tumbling about one's ears all the time! When compelled to use this kind of soil in an artificial nest they sometimes moisten it with water brought from the "moat" that I have previously spoken of (p. 138). "In carrying water for domestic uses," says Miss Fielde, speaking of a certain species, "they probably lap it into a pouch above the lower hip."

I don't suppose you'd care much, just yet, to know that the particular ants she was speaking of are the *Aphenogaster picea* and that the water-container is known scientifically as the *hypopharynx*—

geal pocket. The important thing for you to do is to watch and see if *your* ants carry water. Sir John Lubbock speaks as if it were a common thing for common ants to do it.

Notice around the edges of stones under which brown or red ants have their colonies how they are banked with earth mixed with dead grass blades, leaves, and fibres. Galleries extend under these, so that the colony can get fresh air through this lattice-work and the sun can help hatch the eggs. It's a whole ventilator and incubator system combined, you see. And yet how simple! It takes the Little People to *do* things, I tell you!

This thatching of twigs and sticks also tends to create heat. It's a kind of composite-heap, like the incubators of the Mound Birds whose children never learn to say "Mamma," that I tell about in my "Adventures of a Grain of Dust."

Those little ant craters that you see along paths and the edge of stone sidewalks, what do you suppose they are for? Watch the ants and if you can see how they manage to make them so nearly round you'll beat me! But evidently they're made with great care and they are always restored after they have been damaged by the crushing of a careless foot or disturbed by rain or wind. Doctor Wheeler thinks they may be of use in protecting the nest entrances from wind; a kind of storm entrance, I'd call them, then. One reason for thinking that this is the explanation is that certain Sahara ants raise their craters to a greater height on the windward side.

But just think of making all this fuss about even those little heaps of earth around the door of an ant's nest — bringing information clear from the Sahara Desert to your front sidewalk!

This is a fine time for studying the workings of that wonderful drill described in this department for November. All species of Ichneumon Flies are abundant in July. While some species drill into the burrows of wood-boring larvæ, you'll see others on the trees laying their eggs in the caterpillars at work there. Observe the elaborate system of defense employed by the Puss-Moth Caterpillar, as described in the October chapter.

Do you know the relation between a Sawfly and a Currant Worm? They're each other! The Sawflies that have hatched from those Currant-Worm cocoons are, in July, laying their eggs for a second brood.

At night the moths of the Tent Caterpillars are depositing those rings of eggs on the twigs.

Watch the big moths flying about at twilight, sucking the nectar from the deeper flowers with those long "straws" that they may have put together with so much trouble (p. 156) the very same day. They are very common by July.

Notice how the moths of the apple-worm find crevices that just fit them, for hiding away in the daytime. They can tell whether a place fits them by the "feel" of it. Indeed, they depend so much on this "intuition," this "hunch," in selecting a safe hiding-place that if you put them in a box, part of which is covered to shut out the sun, and on the bottom of it sheets of glass raised on little blocks just high enough for the moths to creep under, they'll hide under the glass, although thus exposed to the sun.

Baltimore Butterflies are laying their eggs on plants in swampy places. Clouded Sulphur Butterflies you'll find in little companies at their fashionable watering-places — pools of water along the roadways. The Compton Tortoise is flying in open woodland and along the roads. In shady places in the woods you'll find the Graylings, that have that dear little trick of dropping to the ground and lying on their sides in order to hide their shadows. On the blossoms of the milkweed you'll find the Great Spangled Butterflies and the Silver Spots.

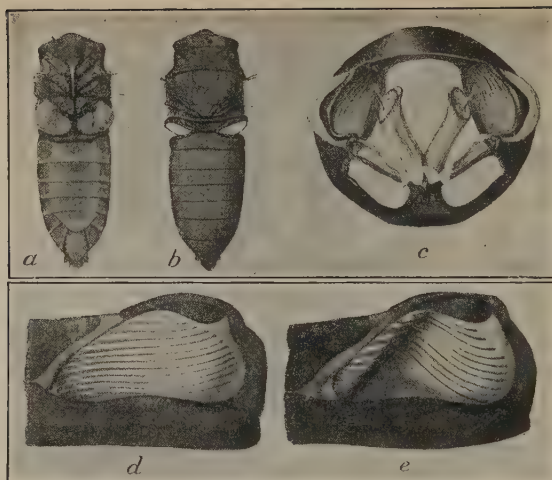
Notice how butterflies, flying or waving their wings when at rest, instantly check their movements when a cloud passes. It seems to dampen their spirits, they love the sunlight so!

With the katydids that by July are grown up and beginning to sing, it's just the other way — they do most of their singing — showing how happy they are — after the evening shadows fall.

But speaking of singing, the cicadas, or Dog-day Locusts, begin coming out of the ground in July and by the later part of the month the woods will be ringing with their music.

Answers

The grasshopper's wing-cases stay locked of themselves when opened, so that he can give all his effort and attention to flying with his real wings, the delicate membranes that he keeps folded up neatly under these protecting wing-cases when not in use. The wing-cases, when opened, also serve the place of the biplanes in a flying-machine, while the true wings act as the motors.



THE FAMOUS MUSICIAN'S MUSIC-BOX

This picture shows you the music-box of the most famous performer in the summer music festival, the cicada. At (a) is a view from beneath showing the plates (light-colored) covering the sounding disks. At (b) is a view of the great musician's back. The light-colored spots are the timbals, the vibrating membranes that make the music. At (d) is shown a timbal greatly enlarged and as it looks when at rest. At (e) is this timbal drawn back by the action of one of the muscles, as it is when the cicada is "singing."

CHAPTER XII

(AUGUST)

THE GREAT SUMMER MUSIC FESTIVAL IN LILLIPUTLAND

It hasn't been so long ago that you've forgotten it, has it? — how you used to help give shows of one kind and another, charging so many pennies or so many pins admission?

Well, then, as we are about to end our present tour through The Land of the Six-Legged as guests at an imaginary music festival in which the leading artists of the year will be represented, what do you say to pretending

that we are the press-agents for this grand event? Then we can introduce it in true "barker" style, with big words and high-flown phrases and all. Something after this fashion:

Ladies and Gentlemen:

We have now the pleasure and high privilege of announcing the oldest and, we say without hesitation, the Greatest Music Show on Earth. The greatest, certainly, so far as numbers are concerned; in spite of the fact that our rivals, the birds, are constantly eating us up and some of us have the unfortunate habit of eating each other.

The Great Summer Music Festival of Lilliputland, as you are, no doubt, aware, Ladies and Gentlemen, begins with the hum of the first bee on her way down to the willow buds in late March or early April, and continues up to the last chirp of the white crickets and the frost of the autumn fields; with early morning, noon, and afternoon matinées (with dancing), as well as early twilight and all-night performances.

Among the features of what we venture to think is an unusually attractive entertainment, we wish to invite special attention to the Nursery Ditty of our Infant Prodigy, the Grub of the Stag-Beetle, to the Solos and Imitation Duets of the Talking Fly, and to the Moth that Sings through Its Nose.

I. THE LITTLE KING OF SUMMER AND HIS FAMOUS MUSIC-BOX

We have chosen the blazing days of August for the introduction of our company, because we *now* have with us the most famous singer in the insect world, a singer of international reputation, known in Italy as the "Cigala"; in France as the "Cigale"; in the United States, England, and the King's Dominions beyond the Seas as the "Harvest-

fly," or "Dog-day Locust"; and in ancient Greece and Rome, as well as in scientific circles to-day, as the "Cicada."

Not only is he so big a bug in the music world, but he, himself, is big — physically big — nearly two inches long, and his song is longer still. He begins it on the day of his birth and keeps it up from about 10 A. M. to late afternoon, for the whole six weeks of his life. He stops neither to eat nor drink; he goes right on when he is taking his meals — singing with one hand and eating with the other, as it were. The fact that he is sucking sap from the tree on which he sits and sings doesn't interfere at all with the music-making part of his anatomy, as we shall presently see.

Like so many of the great opera-singers, he is quite heavy set; you all know him, with his gauzy opera-cloak, his stout body, and square head set close to the shoulders.

That an artist of such powers should stir up the critics is not surprising. The same thing happened to Wagner, for example. Some of the critics could hardly find words to express their feeling of the grandeur of his compositions, while others declared they had no more real music in them than the "bangety bang" of a cook-stove falling down a stairway!

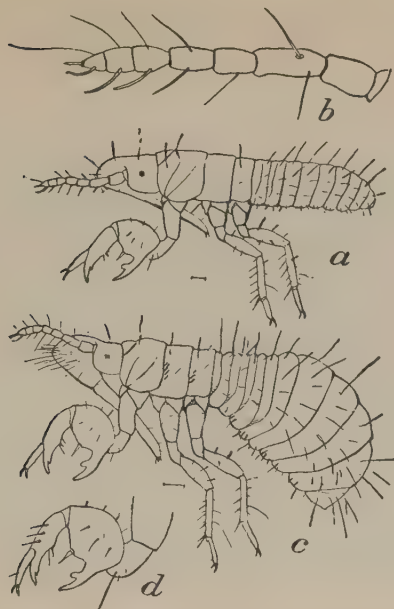
Of the singing of the cicada, take as an example of unfavorable criticism the following:

An intolerable din.

His so-called song is like the rattle of a snare-drum.

Reminds one of an alarm-clock going off and gradually running down.

' Like the whistle of a locomotive.



UNDERGROUND LIFE OF THE SUNLIGHT SINGER

Here are two chapters in the life of the cicada during those long years under the ground. At (a) is the newly hatched larva. He is born, you see, with the spade with which he must help earn his living during those years, already in his hand! At (c) he is eighteen months old; but he hasn't changed, to speak of, has he? I don't need to tell you that at (b) and (d) are one of his antennæ—his feelers—and one of his spades enlarged.

Like the scream of a young snake when disturbed.

A combination of the croakings of a frog and the hum of a distant threshing-machine.

A three-hour squall.

Heard through a megaphone, it was like the bellowing of a bull, and my children, frightened, ran away.

It is Fabre, "the Homer of the insect," who speaks of the cicada's music as "an intolerable din," and who made the

experiments with the megaphone. He loved the cicadas, as he did all the Little People of the Insect World, but their music — no!

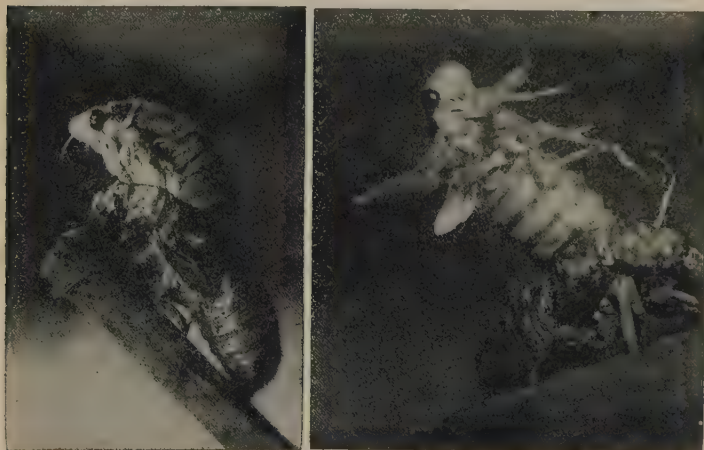
It probably takes a stronger constitution than the dear old scholar had to appreciate such vigorous music. The French peasants, he tells us, speak of it as the pleasant song of the harvest that cheers the reapers as they work, with its continuous "Sego! Sego! Sego!" ("Reap! Reap! Reap!") all through the long summer afternoons.

And to the ancient Greeks, also, with their vigorous health and strong nerves, the cicada expressed the very spirit of Apollo, god of the golden summer sunlight, the whole life of the out-of-doors with all its sounds and sensations. All the Greeks fairly went wild over him, and the poets, from Homer on, sang his praises. "The sweet prophet of summer," "the nightingale of the nymphs," "the sweet singer who lives on dew" — such are some of the tributes.

But how has so small a creature managed to make so much noise in the world? For even two inches isn't big when you think how much bigger all out-of-doors is. See if you can catch that one and perhaps we can find out. While we have been doing all this talking — which he doesn't seem to mind in the least — he has gone right on singing on that twig, while with his long straw, that proboscis of his, he has been sucking the delicious sap. How does he manage to sing and sup at one and the same time?

There you have him! And he goes on and finishes the tune he has begun as if he were wound up like an alarm-clock and couldn't stop. You can feel his body vibrate with his song. Like other truly great opera stars, when he

sings he sings all over. Turn him on his back, but don't squeeze and hurt him, the brave little singer! See, just behind the base of each hind leg is a white, oval membrane,



HOW THE GREAT SINGER COMES ON THE STAGE

This picture shows how the great singer, the cicada, or as an Italian might say, "Signor Cicala," comes on the stage for his grand performance. On the left he is just beginning to change his costume; on the right the process is nearly completed.

very dry, like the head of a drum. But unlike the head of a drum, it bulges up. Running lengthwise across it is a bundle of three or four ribs.

HOW THIS "DRUMMER" DRUMS WITHOUT STICKS

These rib-like things suggest the snares of a drum or the strings of a banjo, but, in reality, they are fastened to the cicada's little drumheads and do half of the drumming themselves! To each of the drumheads is attached, on the under side, a muscle which pulls the drumhead down flat — remember I told you how it bulged up — and then

lets go. The drum "snares" pull the drumhead back into place again, and that's what makes the noise.

Underneath the drumheads are two cavities, with a membrane at either end. These cavities increase the sound made by the vibration of the membranes. The French peasants call them "the chapels" and the two together "the church." Notice our little singer; as his abdomen rises or falls he opens or closes the doors of the church, as you open or close the doors of the Victrola, and the sound swells out or dies away accordingly.

MAKING A DEAD CICADA SING

Fabre, who was always making experiments that only a boy or a genius would think of, wanted to see if he could make a dead cicada sing. He took one which he found under a tree, and with a pair of forceps pulled one of the muscular columns in a series of careful jerks. With each jerk came the crackle of the drumheads. It sounded like "cri-cri." It was not loud, for it was not multiplied by the sounding chambers, as it is when made by the cicada itself.

THE LITTLE CICADA THAT ROARED LIKE A BULL

But while he couldn't make a dead cicada sing with the loud voice of the living, this wonderful Fabre, this delightful boy who never grew up, made a living cicada roar like a bull; well, at any rate, so loud, as I said a while ago, that his little children ran away, they were that frightened!

And what seems strangest of all, at first, is that this cicada is of a smaller species than the ones we were talking about before. In fact, it's only half the size, but it has about two-thirds of itself given up to its music-room. The

noise it made was already so loud Fabre thought he'd see if he couldn't make it sound louder still. So what does he do one day but fit into the opening of the little creature's "music-box" a tiny trumpet made of paper — really a megaphone — with the other end in the mouth of a glass test-tube as a resonator. His little children, coming in by chance just then and not knowing what that papa of theirs was up to this time, "fled in terror" (Fabre's very words, and he adds):

"It was no longer the cry of the cigale but almost the bellowing of a bull."

BUT CAN THE CICADA HEAR ITS OWN SONG?

Did you notice that that cicada, before you caught him — and so it is with all the rest of them — didn't seem to mind our talking at all, but went right on singing? In fact, the cicadas don't seem to mind noise of any kind. Fabre, hiding behind a tree in which a concert was being given, whistled, clapped his hands, struck two stones together, even fired off a small cannon — nobody budged! From this he concluded that the song was not a love-song for the ears of a mate, as are most songs in the insect as well as the bird world, but merely an expression of the cicada's joy of living; and that the cicada himself enjoyed the vibration, although he couldn't hear the sound.

But other men of science don't agree with Fabre, and I don't see how *we* can, for wouldn't it be strange if with "ears" of some sort the rule among insects of all kinds, this tremendous music-maker should be without them? As for the cicadas paying no attention to all that whistling and stone-cracking and cannonading, it was probably because

their ears weren't made to catch sounds of that kind. Ants, bees, wasps, and beetles pay no attention to ordinary sounds. You can fire a gun off near a beehive, and, provided the bees don't feel the air-current, they won't pay any more attention to it than if you had fired it off in the next county.

II. THE SONG-AND-DANCE ARTISTS

The cicadas and the grasshoppers have different ideas about what fine music is and how to make it, but both are inspired to song by the sun. The hotter it is the louder and longer and oftener they sing.

The ordinary song of the cicada is divided into verses, as you might say, and it takes him several seconds to sing each verse. Then, before he starts in on the next verse, there are usually a few moments of silence. But let there come a still, hot day, the kind of day that takes the "tuck" all out of a human being, when the dog goes around panting with his mouth open, and the birds sit in the shade with their beaks apart and their wings raised from their hot little bodies — that's the very kind of a day on which the cicada feels at his very best! Instead of keeping out of the sun, as you'd suppose any sensible bug would do, he keeps edging around into it in a stately sort of dance, with his proboscis thrust in the bark, drinking the sap. Moreover, the pauses in his song between verses are shortened. (Like the songs of the desert Arabs, these verses are all exactly alike. This makes them easier, no doubt, for the cicada to remember!) Occasionally the pauses are left out altogether, but always there is a rise and fall — a "crescendo" and a "diminuendo," as the musical people say.



EMPTY PUPAL SHELLS OF THE PERIODICAL CICADA CLINGING
TO LEAVES

The short-horned grasshoppers are also singers of the blazing sun, and one species of them loves to dance while they sing. Who was it wrote this — was it Riley? — anyhow it describes this artist's performance wonderfully well:

“ . . . the dull grasshopper sprung
Half a man's length up and hung
Tranced in the heat with whirring
Wings, and sung and sung and sung.”

USING THE GRASSHOPPER AS A THERMOMETER

And did you know you can even tell how hot it is by a grasshopper? All you need is a watch, a grasshopper, and a tuning-fork. This is the secret:

The hotter it is the oftener and louder the grasshopper jumps up into the air and sings. So the Wise Men, the scientists, have, by comparing his note with the vibrations of a tuning-fork making the same sound, and at the same time noting the degree of heat as shown by the thermometer and the number of the hopper's high jumps in a given time, as shown by the watch, prepared a little table. This table proves that a certain number of jumps and a certain number of vibrations in the grasshopper's song always accompany so many degrees of heat. Well, then, when a grasshopper performs for him out in the fields somewhere, all Mr. Science Man has to do is to sound his tuning-fork, notice the number of jumps in a given time, and then look at the table, and there's the answer.

Of course the *quickest* way to tell how hot it is, is to look at the thermometer; but it's such fun to see how closely the grasshopper and the thermometer work together! It

must be as much fun — almost — to be a great scientist as to be a great grasshopper on a sunny day !

It was, no doubt, one of the song-and-dance artists that gave a little entertainment, a private performance, for John Muir up on a mountain in California one hot afternoon; for our long-legged friend, the grasshopper, is, among his other accomplishments, a great mountain-climber. Of this and of the artist's skill in song and dance, Muir says: ¹

How high these mountain grasshoppers climb I do not know, but certainly as high as the Yosemite tourists do. I was much amused at the one that sung and danced for me on the Dome this afternoon, springing into the air to the height of twenty or thirty feet, then diving and springing up again and making a sharp musical rattle just as the last bound in the dance was reached.

HOW HE FIDDLED AS HE FLEW

I speak of the grasshopper's note as a "song" (and you see Muir does also), yet the grasshoppers are really fiddlers, as the cicadas are drummers. But what does it matter so long as you know what I mean? Human songs, bird songs — what are they but the twanging of musical instruments, the vocal cords in music-boxes?

The song-and-dance artists, the kind of grasshoppers that make their music while flying, produce their notes by rubbing together the surfaces of the wing-covers. This can only be done while flying. You've often seen one of these big, brown, roadside hoppers fly up into the air, haven't you, and hold himself poised for some time, while he performed in wild delight? Whatever *you* may think of his music, *he* evidently enjoys it immensely. He has what human music critics call *verve*, artistic enthusiasm!

¹ "My First Summer in the Sierras."

Another of the shorthorns — he's brown, too, and commonly found in meadows and by the roadside — has on the inside of his femur, or "thigh" bone, a number of very fine ridges. You can see them with a fairly strong glass. These he uses to make music by drawing them across his wing-covers.

Still another type of grasshopper musician bends the shank of his hind leg beneath the thigh, slips it into a little furrow *in* the thigh (evidently made on purpose), and jiggers it up and down as a fiddler plays his bow across the strings. I see one book on grasshoppers says he plays *both* of his leg fiddles at once, but this is incorrect; what he really does is to play first one and then the other. You watch and see.

THE LONG-HORNED MUSICIANS OF THE MEADOWS

The long-horned grasshoppers stick pretty closely to the taller grass of the meadows. Apparently they want to get up a little where they can see things, but not into trees, like their cousins the katydids. This is how they play their music. The wing-covers are enlarged at the place where they are attached to the back and have big veins on them. These veins are ridged, and when the veins of one wing-cover are drawn across the edge of the other wing-cover the wing vibrates, that is, quivers very rapidly and gives out a high note. But it is not a shrill note. It is one of the soft and pleasing sounds of the meadows in hay-ing-time. The song goes like this: "Zip, zip, zip, zee-e-e-e."

Some of these meadow musicians prefer to sing about noon, but many join the opening choruses of the katydids in the evening.

The meadow hoppers dress in bright green or pale brown. It was of one of the noonday performers that Leigh Hunt wrote those lines:

“Green little vaulter in the summer grass
Catching your heart up at the feel of June,
Sole voice that’s heard amid the lazy noon.”

You see, there weren’t any cicadas about in June or he wouldn’t have written that line about the “sole voice.” The cicadas come along in late July and early August.

HERE’S A REAL FIDDLER!

But of all the grasshopper musicians, the one that has the fiddle idea worked out the best, it seems to me, is a species in South Africa. He plays over a hollow sounding-box, just as the violinist does. He doesn’t use his wing-cases at all. The hinder part of his body is inflated, like a toy balloon, and you can almost see through it. That’s his sounding-box. On either side of it are ridges. On these he makes his strokes with his fiddle-bows, his small hind legs, and gives nightly concerts.

Another grasshopper musician of the Dark Continent gives a wonderful volume to his voice by a very elaborate device. His whole system, almost, seems to be devoted to the business. He not only has ridges on the under side of his wing-covers, but in his body, and his segments or body rings are, some of them, overlapped, so that when he draws the pegs on his thighs back and forth between the wing-covers and the body, you get a grasshopper solo that can be heard a quarter of a mile!

A very unusual thing about the musicians in this South

African family is that the females also make music in the same way. Usually, you know, in this queer little world, the ladies would rather be sung to than to sing. The males are the singers, and nearly always, as the Greeks said of the cicada, "they have voiceless wives." This lady grasshopper's note, however, is much lower than her husband's, and he has two songs, one of which is very like hers; possibly for duets.

But the most remarkable thing of all about him is that while he has both wings and legs, he never uses his wings for flying nor his legs for jumping. They are simply parts of his musical outfit.

Not for him the leap into the air, the whirring wings in the glad sunlight! All sacrificed for his art!

III. THE MONOLOGUE DIALOGUE OF THE TALKING FLY AND OTHER SPECIAL FEATURES

"You have now, Ladies and Gentlemen, in Parts I and II of our programme, heard the two leading classes of artists who furnish the music for the day performances of our summer fields, the cicadas and the grasshoppers. We have reserved for Part III certain features, the interest of which will, we believe, more than make up for the fact that they appear among the concluding numbers of our entertainment:

"The Monologue Dialogue of the Talking Fly, the Three Songs of the Potter Wasp, the Moth That Sings Through Its Nose, the Bumblebee Who Plays 'The Campbells Are Coming,' and the Love Serenade of the Innocent Little Beetle Whom Foolish People Call 'The Death-Watch.'"

THE MONOLOGUE DIALOGUES OF THE TALKING FLY

I can't just think now how the rest of it goes, but I remember a piece in my school reader about a certain "Orator Puff," and in it were these lines:

"Oh, ho! Orator Puff,
One voice for an orator
Is surely enough!"

If that could be said of an orator, how much more of a fly? Why, just think of his having any voice at all; I mean a voice that would say things like a human being. It's the weirdest thing!

If you've never heard him, just wait until you do, and you'll see! Some of these sunny August days, maybe, you'll be sitting in the shade with a chum, on your way from the swimming-hole or from fishing, and you'll think you hear some one talking — sounds as if he were talking to himself — it's all one voice. And he's pretty close by. No! It's two people quite a distance off; two old farmers it sounds like, talking about the crops or the weather, and wondering whether it's going to rain.

No, sir! It's just *one* man, as you said at first, and he's driving oxen. He must be away over the hill there somewhere. Hear him:

"Ha-a-aw-w-w!"

Well, whoever he is or they are, he is or they are talking through his or their noses, anyhow!

But let's be very quiet — all of us, you and I and the other boy — and keep our eyes and ears wide open and look around without letting on that we hear anybody. And

presently we'll see only a few feet away, on a twig, maybe, the little chap who is doing it all — the Talking Fly!

William Hamilton Gibson tells in "Sharp Eyes" of his first meeting with one of these quaint little masters of monologue. The famous artist was sitting under a hazel-bush in the shadow of a stone wall, examining a flower, when he thought he heard men's voices. At last he saw right in front of him, on a hazel twig, the big fly that was doing it all. With a sweep of the hand Artist No. 1 tried to catch and so get better acquainted with Artist No. 2. But the hand that could in word and line catch and record so marvellously well the form of flower and insect and climbing vine, and who had also learned to be mighty clever at catching flies and other flying things, wasn't quick enough this time.

"Ba-a-a-a-a-a-a-a-a!"

So sang the mocking voice, as its owner flew away. This note was "drawn out into a long nasal perspective," says the artist; using the terms of the draftsman's craft to describe sound. He also calls this flyaway note "a twanging buzz."

HOW THE BUMBLEBEE PLAYS "THE CAMPBELLS ARE COMING"

Observe (1) that the Talking Fly's buzz became a "twang" (*i. e.*, a louder note) as he flew away, but (2) that it was while he was sitting still that he did the other talking. Now listen to how the bumblebee plays "The Campbells Are Coming," and see if you can tell why these things were so.

If you lift the dome of a bumblebee's nest, several of the burly little warriors will throw themselves on their backs

and begin to hum. Yet it isn't the hum of industry, the song of the worker, but the angry war-song of the tribe. We may compare it to the drone of the bagpipes playing "The Campbells Are Coming" as the Black Watch goes to battle. The bumblebee is going to battle, too, if you touch her; for she throws herself on her back, so that she will be in a better position to sting.

And her drone comes through bagpipes, too. You can see for yourself that she doesn't make it with her wings. How can she, when she's flat on her back? The sound is made by the rush of air through the breathing tubes, to be found at intervals along the sides, not only of bumblebees but of insects in general. These tubes open into a little enlargement of the bumblebee's air-pipe, which corresponds, let us say, to the bag of the bagpipe, while its breathing tubes correspond to the "chanter" and the "drones" — that's what they call the bagpipe tubes — of the bagpipe. The chamber, or enlargement of the insect's air-pipe, has in it certain hard bodies that vibrate and make the droning sound given out by the "talking fly," the bluebottle, and the bee. You make a similar noise in a similar way with a piece of tissue-paper and a comb. The "twanging" sound made by the talking fly as he flew away was due to the fact that his wings were in rapid motion, and this motion increased the vibrations of the little objects in the "bag" of his "bagpipe."

THE THREE SONGS OF THE POTTER

With a similar bagpipe the digger-wasp hums when she's digging her burrow; and the mud-dauber wasp when she's gathering mud.

I have told you about our mud-dauber wasps and their songs. Down on the Amazon there's also a potter wasp that has three songs. She is large and dresses in yellow and black. One place you can see her at work and hear her sing, if you should ever happen down that way, is at the clay banks just outside the town of Santarem. One of the industries of Santarem is pottery-making, and both the wasps and the human potters get their clay at the same banks. When digging her clay at the pit the wasp has one song, another when she flies back to her nest, and still another while she is building.

SINGING MOTHS AND BUTTERFLIES

You could hardly expect a moth or a butterfly to sing very well, as gifts are divided up by Mother Nature. The peacock, for example, because he has such a beautiful tail, I suppose, has nothing in the way of a song but that squawk; and the moths and butterflies might well be satisfied with their beautiful dresses. But some of them also have voices. You know the butterfly called the "Yellow Edge"? It's very common. Well, there is a species of these butterflies in Europe that have along the lower edge of the front wing a thick vein. This vein is notched, and when the wings are spread in flight this vein rubs against a similar vein on the hind wings, and with this musical instrument young Mr. Yellow Edge makes a little love-song for the ears of his mate. It sounds like the faint tinkle of a brook. It is thought our American species, which have similar wings, may have a similar note, but nobody has reported having heard them. There's another chance for you.

Singularly enough these butterflies, with their tinkling-brook song, frequent the willows by the brookside in successive broods from mid-April clear to autumn. The eggs hatch into little, black, spiny caterpillars.

The Death's-Head Hawk-Moth sings through its nose — actually! Its note is a plaintive squeak made by forcing the air through its proboscis, much as an elephant blows his trumpet. Doesn't it beat all, without newspapers or magazines or any such thing, how ideas get around in the animal world like that? But did the moth teach the elephant to trumpet or the elephant teach the moth to squeak?

And then what are you going to say when I tell you that not only the caterpillar but the chrysalis of this moth makes the same kind of a squeak? The chrysalis, mind you! I'd as soon think of an Egyptian mummy reciting the multiplication tables, wouldn't you?

But it's true! Yes, and I know of another infant prodigy in the world of the Six-Legged, and that's the grub of the Stag-Beetle. He has what is thought to be a warning note for grubs who are working on the other side of the partition of his own little burrow under the bark, so that they won't cut through and trespass on each other's "claims," as men say in speaking of other kinds of mining claims. With a hand-glass look at the lowest joint of his second pair of legs, and you'll see a broad, file-shaped space, and on the third pair of legs some hard file-like points. With these he scrapes the file, and so makes a sound.

SOME MUSICAL BEETLES

There are several members of the beetle tribe that are musically inclined, including the kind that come bumping

around the family lamp in the evening, and the ones that you will find in little groups in the sun on the twigs of trees, in their spotted cloaks of gray and ochre and yellow. You'll see them nod their heads up and down in the quaintest way, as if keeping time to the squeaking music they make. Their heads are set in a kind of little collar, and it's the working of their heads in this collar that makes the squeak. In other words, it's the "keeping time" itself that makes the music they seem to be keeping time to! Isn't that a combination for you?

"DEATH CHANT"? NO, INDEED! IT'S A LOVE SERENADE

But the best known of all the beetle performers is the little creature that gets into furniture and the wood of houses. He is famous, not because his music is so striking, but because foolish people long ago started the story that where his "tap, tap" is heard there is sure to be a death in the family, and they named him "the death-watch."

Now, all there is to this idea is that in the quiet of the sick-chamber this tap is easily heard, although it isn't ordinarily noticed because it is so faint.

And what do you think that tap really is? It's the little beetle's love signal for his mate! Webster's dictionary says he makes the sound by knocking his head against the wood, but this isn't quite right. He makes it by a kind of pecking movement, rising on his two front legs and then falling on his face, as it were, like a Mohammedan at prayer.

As music, I as much as said a moment ago, it doesn't amount to anything, but I was only speaking from a human standpoint, you understand. I haven't the least

doubt in the world that little Mrs. Beetle, in her own chamber which she has dug in the dry wood, thinks it's just fine!

HIDE AND SEEK IN THE OPEN

(STRANGE AND CURIOUS THINGS TO BE SEEN IN THE LAND OF THE SIX-LEGGED IN AUGUST. CONSULT INDEX ALSO, UNDER "MONTH BY MONTH")

Have you been going into wasp society much this summer? One doesn't like the idea of missing the Waterloo Ball (p. 77), but it would, no doubt, be safer for the average boy to read about it than to undertake to be "one of those present."

To be properly received in the homes of the wasps one must have, in a high degree, what in human society is called "poise." One must, under all circumstances, remain calm and self-possessed. If you watch them day after day and remain calm, say the two famous wasp students, Mr. and Mrs. Peckham, the wasps apparently come to regard you as part of the surrounding scenery; although occasionally, even after many visits, some suspicious wasp may buzz up uncomfortably close to your face, as if saying:

"Who are you, anyway? And what are you doing here?"

The Peckhams consider the study of the burrowing wasps the safest, but Step, the English naturalist, finds tree-wasps quite hospitable. He stands for an hour at a time, with his face only a few inches from their doorway, "always taking care to remain calm and unflurried," says he.

That's what we'd have to do if we went to the Waterloo Ball — stand in the doorway and look in. All through August, however, the colonies of hornets, wasps, and yellow-jackets — all members of the wasp family — are busy enlarging their nests, visiting golden-rod and other flowers for nectar and the aphides for honey-dew to satisfy their own wants, and hunting caterpillars and other forms of insect game for their young. All this you can safely observe.

And you can watch certain species feed their babies the larvæ, and see the young winged wasps at play, keeping at a safe distance and using a field-glass if necessary. Young burrowing wasps, like young bees, have their play-time. For a while life is a holiday;

they bask in the sun, sip nectar from the flowers, and sleep at night under some sheltering leaf. When playtime is over they begin digging their burrows and putting up canned meats for their children, as described in Chapter XI.

But the hornets, as you can observe, instead of "canning" their meat, feed it to their young in the form of "Hamburg steak." When a worker hornet has caught a fly, she hurries with it back to the nest. Then holding on to the nest by her hind legs, she hangs, head down, with the fly between her front feet, and bites off its wings, trimming it as a butcher trims a piece of meat when he is cutting off the uneatable parts. Then, much as the butcher chops up meat for Hamburg steak by running it through his machine, the hornet chews the fly into a pulp in her sharp jaws. Then she feeds it to the little wasp-worm babies, who stretch out of their "cribs" to get their share, like young birds in a nest!



WASP CARRYING A CL-
CADA TO HER BURROW

But be careful there, little Mr. Hornet! You're stretching too far, and you're liable to fall out! If you do, that will be the end of you; for older sister hornet, although she'll work her head off bringing you food, simply won't put you back!

When a hornet grub hatches from the egg, it remains at first with its tail in the egg-shell and craning its head to the mouth of the cell for food from the workers. But as it grows it must change its position to avail itself of the full accommodation the cell affords. It has two things to hang on with, its jaws and a kind of sucker on its tail. So if it lets go with one end before it has made fast with the other, it falls headlong from its cell. This happens quite often — every day, no doubt, taking in all the nests here and there in the neighborhood. You'd think this daily shower of babies from the ceiling would teach the nurse sisters that those upside-down cradles are simply not safe! No place to leave a baby in without strapping! A strap made of a bit of silk, such as some of the caterpillars use when posing as twigs (p. 77), or when changing their clothes (p. 86), would do the business. But no! The nurses rarely attempt to put a baby back. In fact, they are much more

likely to pick it up from the roof of the adjoining comb, where it has fallen, carry it out, and drop it some distance from the nest!

What a Spartan code! But by hanging on with that sucker tail of his for a while, the hornet baby soon grows so big and fat he fills his crib and then he *can't* fall out.

From ten to fourteen days after hatching, the grub spins itself a silk nightcap, goes to bed, and wakes up a full-grown wasp with wings. This "nightcap" is a silken cover spun over its cell, in which it then changes to a pupa and later emerges in its final form. Like the bees and the ants, these members of the wasp tribe spend an apprenticeship in the nest before going afield. During this time a young wasp is chiefly engaged in helping "paper" the nest (*i. e.*, enlarging it), but in about three weeks it runs out of paste; that is to say, its salivary glands, from which the paste comes, are exhausted, so it has to go at something else. Accordingly, it devotes itself to feeding the young.

While human beings and birds and dogs and pretty nearly everybody else I know of outside The Land of the Six-Legged keep in the shade these blazing August days, the wasps are revelling in the heat. The higher the thermometer rises, the faster they fly and the louder they hum. And in connection with their flying, here's something you can do that shows the wasps had the principle of "traffic both ways" long before the great railroad empire-builder, Hill, ever thought of it. Put a bowl of water on the table and leave the window open.¹ The wasps will come to get a drink. The hot weather and the hard work make them thirsty. If they are burrowing wasps they will be quite apt to leave the pellets of clay they bring with them. When digging out their burrows they carry a pellet of clay on leaving — to get rid of it, as explained in Chapter VIII — and bring back their baby food when returning.

On a cool, cloudy day — just the time when a human being can work with some comfort — what do they do, these burrowing wasps, but disappear in their holes and lean out of their doorways, resting on their elbows, as Mrs. Bembex is seen doing on p. 167! Their favorite hours for work are between 11.00 A. M. and 3.00 P. M. — the very hottest part of the day!

No matter how much noise you make, you'll see the wasps won't pay any attention to it — don't seem to hear it. It is thought,

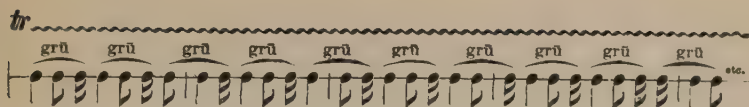
¹ No, better do this on the porch. I forgot about letting the flies in! Hope I didn't get you into trouble with the similar suggestion about the bees in the "H. and S." for July.

perhaps, they are sensitive to certain sounds that apply to their business. A telegraph operator, you know, in the midst of all sorts of hubbub, hears only the conversation of his instrument, and so the wasps can hear wasp speech, apparently. The angry buzz the wasp makes, for instance, seems to be a battle-cry which the other wasps understand. Then look out!

But I've had enough of wasps and the hot August sun for the present, haven't you? Let's get into the shade with a cooler subject — the tree-cricket, for instance, and the katydids and their songs as the twilight shadows fall and the evening breezes begin to play. The tree-cricket matures and begins singing in July, unless the season is very backward, and are in full chorus in the late August evenings. You can also find plenty of black crickets in the fields and around logs. And they have begun sinking their little shafts in the ground along roads and pathways, and laying their eggs in them much as Cousin Grasshopper does, so far as the making of the shafts is concerned. Several species of katydids are also abundant in August, and may be found feeding on the leaves of various plants and laying eggs.

All insect singers who may be lifting their voices at the same time make a kind of orchestra, but the tree-cricket seems to *know* they belong to an orchestra! If you listen as evening is coming on you'll hear one singer begin. Then another will join in, but they won't keep time at first. It's a kind of "seesaw," as Mrs. Morley expresses it, of accented and unaccented notes. But, after a while, the two will get to singing together beautifully; perhaps, however, not until a good many more players have joined the concert. But when the rhythmical beat is once established, it is in as perfect time as if governed by the baton of an orchestra leader! They go on singing late into the autumn. Sometimes, after the cool nights come, one part of the orchestra in an orchard will be out of tune with the rest, and the discord may continue for some time, as if the players were too cold and sleepy to pay close attention.

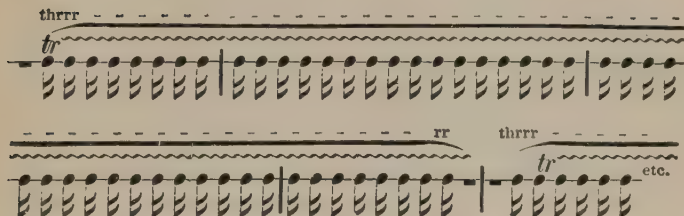
Each species has a tune of its own, "the *tempo* depending on whether it is night or day, sunshiny or cloudy, warm or cold." Some students of cricket music become so expert that they have discovered new species by ear, even when a careful study of the insect's structure and markings was necessary to determine the point. To the uninitiated the song of the tree-cricket sounds like the word "re-treat" endlessly repeated.



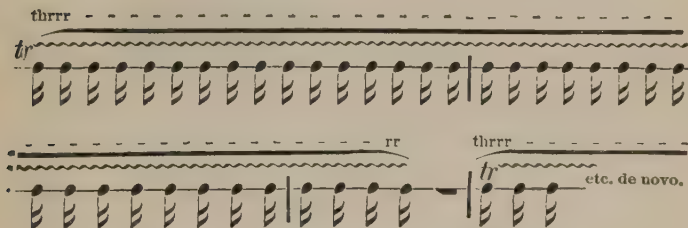
Song of the mole-cricket. (*After Scudder.*)



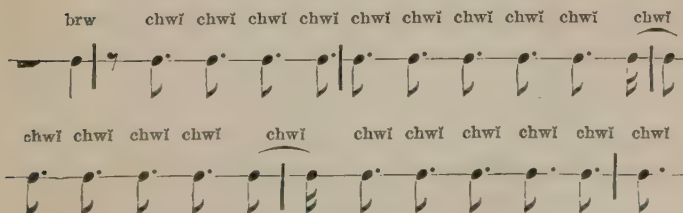
Song of the field-cricket. (*After Scudder.*)



Day song of the snowy tree-cricket. (*After Scudder.*)



Night song of the snowy tree-cricket. (*After Scudder.*)



Song of the cave-cricket *Ceuthophilus ensiger*. (*After Scudder.*)

NOTES OF THE DAY AND NIGHT SONGS OF THE CRICKETS

The tree-cricket is delicate green, or greenish white. They live in shrubs as well as trees, and are hard to find because of their protective coloring. They also have the art of the ventriloquist, which you will hear Fabre explain to us later.

The male cricket sings down in his burrow, and that, perhaps, is why he seems to have a low bass voice. He begins about the mid-

dle of the afternoon, but grows more vigorous toward night, with his "Grew! Grew! Grew!"

"The Cricket on the Hearth" that Dickens wrote that charming Christmas story about is a European species which is not so common in this country, although it is sometimes found in greenhouses and in dwellings. The large black field-cricket, however, take readily to human society, and you can make pets of them and see just where they



MODEL OF CRICKET'S LEG TO
SHOW THE EAR

keep their "chirp." A lantern globe set on soil in a flower-pot makes a good cage. (They must have fresh air, you know.) Feed them lettuce, moist bread, and, "especially if you have a numerous family, the members of which are inclined to eat each other," says Doctor Lutz, in the "Field Book," "some bonemeal." If you wish to hatch little crickets from the eggs, put them in the soil and water it as you would for plants.

Now for the chirp. Across each wing-cover of the male extends a vein covered with transverse ridges, making a kind of file. On the inner side of the wing-cover is a hardened portion called the "scraper." As you watch him when singing to his mate, you may think Mr. Cricket ought to take lessons in facial expression; his fierce, swelled-out, and bristling appearance is so out of keeping with one's idea of a love-song! But then think of the grand-opera lover under the same conditions. Doesn't he often look to you as if he were about to suffer an apoplectic stroke? The cricket's "expression" is due to the fact that he is lifting his wing-covers so as to draw the scraper of one across the file of the other.

Cricket, katydid, and grasshopper all have their "ears," their hearing pits, on the tibia of their front legs.

You've often heard the expression, "spry as a cricket," haven't you? Well, if you've never tried to catch a cricket you don't realize how spry he is! A good time to catch him is on a rather cool day, when he has come out to sun himself at the edge of the stone, where, with Mrs. Cricket, he makes his home. You'll not only have to be quick with your hands but sharp with your ears, for he's something of a ventriloquist, he is! Listen! Go toward the sound. Be quiet again! When the sound is loudest look around and you'll see him with raised and quivering wings, his head down, and his feelers pointing toward his lady-love. Grab! Now watch for the female. You'll know her by her straight, lance-like egg-layer. Put the two inside the glass house as described. In addition to the bill of fare already mentioned, you can add bits of fruit, cooked meat. And you should give them water occasionally in some little thing — a salt-cellar or the cap of a bottle. That they may enjoy all the comforts of home, they should also have a little stone and leaves to hide under. Then you can not only hear the singing, but see the whole family life, including the egg-laying.

Fabre tells, in his own inimitable way, of his experience with one of those cricket ventriloquists at night. "If not disturbed his note does not vary, but at the least alarm he becomes a ventriloquist. First of all you hear him here, close by, in front of you, and the next moment you hear him there, twenty yards away! You go forward. Nothing is there. The sound is to the left now — unless it is to the right — or behind! Much patience and many precautions will be required before you capture him by the light of the lantern."

Fabre goes on to tell how the ventriloquist does the trick. "When the note is at its full volume the wing-cases are well raised above the body. The sound can be modified by strokes of his bow, but the illusion of distance is produced mainly by the lowering of the wings, so that they press on the flanks, thus diminishing the vibrations and tamping the sound."

In your little cricket house at home, notice how Romeo will often take a stand under Juliet's window (that is to say, at the entrance to the burrow) and sing quite loudly until she appears. Then he will drop to a subdued note as he caresses her with his feelers. In his "native land," out in the fields, he will often stand in the family doorway waving his antennæ in the air, and then dodge back and

scramble to cover when so much as a shadow passes over. It might be the shadow of a bird, you know!

Ground-cricket has very long and sensitive antennæ, which, like a blind man's cane, as it is supposed, help them in feeling their way through the dark corridors of their homes.

In Africa the natives rear crickets and sell them to people with the assurance that their soothing cry will produce sleep.

Now, about the great question as to what Katy, whose voice we hear in the evening from August to late autumn, really did — do, sing, or say! There seem to be three notes, the first and third being accented — “Ka'-ty-did'.” At least, that's how it sounds to Mrs. Morley, but she adds: “Yet the more you listen the more you doubt whether it is the music or the listener's imagination.”

Doctor Howard, head of the Bureau of Entomology at Washington, on the other hand, says our little friend doesn't say “Katy did” at all. According to this high authority, it says “Katy” or “she did” — that is, rasps with the wings twice and not three times. These notes, he says, are repeated at the rate of 200 per minute. (If you doubt it, count them!)

The katydids give both *matinée* and night performances. The concert begins in late afternoon and continues without ceasing until just before dawn. Mrs. Morley thus describes the all-night performances: “In the small hours the rhythmic beating becomes slower, and toward dawn there is a falling off in the number of players, the beat is still slower, and the notes hoarse, as if the little singers were tired and cold. Finally, when only two or three are left, the music stops abruptly.”

If you are sitting next to a katydid on a nice bright summer day, and he's singing, and a cloud happens to drift over the sun, you'll notice an odd thing — he'll immediately change his note! The reason is, the katydids have a day song and a night song. When the sun is shining they sing the day song, and when a shadow falls they seem to think it's night, and start up their night song! If you learn these notes and repeat them, “Katy” will answer you.

Don't forget that the girdler-beetles begin making the wooden cribs for their babies in August, and keep it up until November, as described in the November chapter. Watch them at their wood-turning.

Answers

UNLUCKY NUMBERS IN BEETLEDOM

Thirteen, or any other odd number, is a sign of bad luck among burying beetles, because they live together as mates, and if you see groups at a burying that won't divide by two it means that something has happened to a member of one of the couples.

THE STRIPES OF TIGERS AND CATERPILLARS

Many caterpillars wear stripes for the same reason the tiger does — so that they won't be seen so easily. These stripes mingle with the sunlight and shadow of the "jungles" of the grasses and weed stems. Take the striped caterpillar of the Monarch Butterfly, for example. Alarm him in any way, and he'll double up in a ball and drop. Even if you think you see just where he falls, you'll learn that it isn't so easy to find him. Late broods of Monarch Caterpillars will be hatching in August, and you can try it.

For the same reason caterpillars that feed on the needle-like leaves of the pines are commonly marked with strongly contrasted colors running lengthwise with their bodies.

INDEX

For numerous practical suggestions as to the use of an index, the reader is referred to the preface to the index in the author's "Strange Adventures of a Pebble."

- Antennæ, their various uses by the insect, 15
- Ants, their extraordinary skill in using the few tools they possess, 6; ease with which their habits can be observed, 21; their retirement to their winter homes, 24; their cat-naps, 51; when the ants first appeared in the world of life, 102; their model system of government, 132; Martha Washingtons of the ant republics, 132; the only time an ant queen is really a queen, 136; ants as pets, their teachableness, 138; spring housecleaning in Antdom, 164; how the ants take care of their live stock, 185; their house hunting and house renting, 197; what they use for an alarm-clock, 197; their habits compared with those of the grasshoppers, a scientific study of an old fable, 209; playtime of baby ants, 254; the deaf-and-dumb language of Antdom, 254; the water-buckets of the ants, 255
- Aphides, the "cows" of the ants, and the mistakes of scientists as to where the "milk" comes from, 19; what the aphides are doing in September, 24; curious facts about them, 44; incredible rapidity with which they reproduce, 44; how the ants take care of them, 184
- Bats, their service as night policemen in the orchard, 37
- Bees, versatility in the use of their mandibles, 7; intelligence compared with that of flies, 11; Fabre's experiments to determine the intelligence of the mason bees, 10; how the bees responded to the advertisement of new brands of "varnish" and pollen, 11; sense of smell and of direction, 15; how they study geography, 16, 253; timidity of young bees, 18; swarming day the only great national holiday, 19; ease with which their habits can be observed, 21; how bumblebees go into winter quarters, 47; honey-bees never sleep, 51; when the ancestors of the bees first appeared in the world of life, 102; why you seldom see a hive bee on red clover, and why it would pay you to see one, 109; bees that die of homesickness, 120; Maeterlinck's error as to the conditions under which bees

- swarm, 122; origin of the tin-pan superstition, 122; origin of community housekeeping among bees, 124; their knowledge of botany, 126; remarkable extent of their vocabulary, 128, 207; the queer birth permits for the bee princesses, 136; the time locks on the royal chambers, 137; birthday parties and birthday dances in Beedom, 140, 147; how Mrs. Bumble makes her birthday cake, 140; her rainy-day honey-pot, 141; Mrs. Carpenter Bee's cookies for her children, 144; where the youngest may be the first-born, 144; family etiquette among the bramble bees, 145; how baby bees are weaned, 149; getting baby bees a drink, 150; spring housework among the bees, 165; their house-hunting troubles, 190; the playtime of young bees, 206; how the youngsters "show off," 206; the bee jelly jars and the little "stoves" that make the jelly "jell," 242; how the white-clover blossoms keep books for the bees, 248
- Beetles, their interesting habits, 45; after-dinner naps of the tumblebug, 50; how the winter winds help Mrs. Girdler Beetle put her babies to bed, 58; the sacred beetle and its baby bed in the sun-parlor, 60; why this particular beetle was sacred to the Egyptians, 60; how the birch beetle tucks her baby's bed in at the foot, 63; how the ladybirds and June-bugs spend the winter, 73; how the click-beetle clicks, 115; how a certain beetle does up neat packages without string, 116; why Mother Goose told the ladybird to "fly away home," 185; queer little beetles that board with the ants, 226; a fellow beetle boarder that eats with a spoon, 227; Fabre's study of the engineering skill of tumblebugs, 242; the tiger of the beetle world and how to meet and capture him, 251; contributions of the beetle family to the great summer music festival, 278; the truth about the "death-watch" beetle, 278
- Birds, their great service in checking the increase of harmful insects, 28, 77
- Boys, Dan Beard, and Fabre on their capacity for scientific observation, 21
- Brain, mystery of its workings as great as that which surrounds the subject of instinct, 20
- Bumblebees. (See Bees)
- Burbank, why he pays a high price for horseradish seed, 109; how the evolutionary theory helps him in his work, and what he has found that contradicts part of the Darwinian theory, 111
- Butterflies, winter balls among the butterfly people, 79; when the ancestors of the butterfly first appeared in the world of life, 102; birthday parties in Butterflyland, 150; the Monarch butterfly's birth dance, 151; how the butterfly puts on its wings, 154; how the Monarch puts his "nose" together, 156; the Monarch butterflies as aviators, 234; singing moths and butterflies, 276

- Canker-worms, as Napoleons of strategy, 76; how to deal with them, 77
- Caterpillars, that make faces to scare their enemies away, 28; Fabre's description of the burial ceremonies of the Processional Caterpillar of the Pines, 161; purpose of the wrinkle in their foreheads, 161; about certain caterpillars that the ants use as "cows," 186; how you can prove that caterpillars are near-sighted, 253; why striped goods are so popular in Caterpillarland, 253
- Chrysalids, how the caterpillar makes that rubber coat, 85; how to gather chrysalids in the fall and keep them over winter, 88; what to do with them in the spring, 186
- Cicada, its strange life underground and its return to the world of sunlight after many years, 67; its famous music-box and how it works, 259
- Clothes-moths, their skill in making travelling suits, 35
- Cockroaches, their ancient ancestry, 101; how some of them lost their wings, 106
- Codling-moths, and the night police of the orchards, 37; how to help the police, 44
- Crickets, things to be observed about them in September, 24; their late parties and how they go to bed for the winter, 48; their place in the summer music festival, 282
- Cutworms, how they retire for the winter, 43, 75; how they attack orchards and how to attack them, 187
- Darwin, his mistake about the California bees, 21; his greatness and his relation to the evolutionary theory, 110; why some of his explanations of the process of evolution are now discredited by scientists, 110
- Dragon-flies, with wings two feet across, 102
- Earwig, why "ear" wig?, 101; insects that sit on their eggs and brood their young, 101
- Evolution, what men of science mean by the term, what people who don't know *think* they mean, and points on which the evolutionists differ among themselves, 95, seq.; what the Bible has to say on the subject of evolution, 112; how the facts of evolution help to prove the greatest truth in the Bible, 112
- Fabre, his experiments and comments on the question of the intelligence of insects, 10; tribute to the value of the assistance of his little son Paul, 21; his discoveries with regard to the habits of the sacred beetle, 62; his experiments with tumblebugs, 232
- Flies, intelligence compared with that of bees, 11; how they spend the winter, 90; how to make one of these winter flies tell you how all insects walk, 90; the fly that pretends to be a bee, 208; the talking fly that poked fun at a famous artist, 274
- Geology, what it has to say about the origin of insects, 90

- Gold-beetles, their beauty and how to find them, 45
- Grapevine-borers and their work, 74
- Grasshoppers, how they lay their eggs, 25; why you can sometimes see them hopping about in winter, 113; the habits of grasshoppers contrasted with those of ants, a scientific study of an old fable, 209; the grasshopper's place in the great summer music festival, 268
- Hornets, how they spend the winter, 77
- Ichneumon-flies and their wonderful drills, 70; how a member of the ichneumon family helps out with the cabbages, 85
- Insect, defined, 2; remarkable industry of insects, 5, 49; their senses, 13; how most of them get along very well without brains, 13; insects have no sense of pain, 13; do some insects hear light?, 14; mimicry and other self-protective devices, 26; what becomes of them in the winter, 48; their sleeping habits in summer, 49; how they walk, 90, 116; their origin, according to the evolutionary theory, 95, seq.; their great antiquity, 100; model systems of government in the insect republics, 119
- Instinct, a child's excellent definition of it, 8; Fabre's experiments and comments on instinct, 9; compared with intelligence, 9, 19, 127
- June-bugs and their ways, 231
- Katydids, what they really say in their matinee and night performances, 286
- Ladybird. (See Beetle)
- Lubbock, Sir John, his studies on the comparative intelligence of flies and bees, 9
- Maeterlinck, his comments on Lubbock's studies on the comparative intelligence of flies and bees, 9; on the response of bees to the "advertisement" of a brand of pollen substitute, 11; on the sense of direction of bees, 16; on the timidity of baby bees, 18; his repetition of Darwin's mistake about California bees, 21; on the patriotism of bees, 122; his error as to the cause for swarming, 122; on the bee news-gathering system, 125; on the birthday dances of Beedom, 147; on the wax-making methods of the bees and the "supervising architect," 244
- May-fly, his short and merry life, 50, 208
- McCook, Dr., his experiments with sleeping ants, 52
- Measuring-worms, why they "measure," 116
- Month to Month observations (these are in addition to those in the "H & S" Departments at the ends of chapters). August movements of ants, 24; swallowtail butterflies to be seen from June to August, 30; in June and July look out for the apple fly, 43; from July to October look for gold-beetles, 45; in August Mrs. Girdler Beetle begins prep-

- arations for putting her babies to bed for the winter, 59; in May the babies awaken, 59; underground sojourn of the sacred beetle from June to September, 63; the leaf crumpler comes of age in June and in July becomes a moth, 66; in July and August the cicada returns from his wanderings in the underworld, 67; in August watch the ichneumon-fly work its wonderful drill, 70; from March (in the South) to June (in the North) the grape-vine-borer is laying its eggs, 75; canker-worms come out in January and February thaws, 76; the last broods of winter butterflies are still feeding in October, 79; in January and February thaws look out for the midwinter balls of the butterflies, 81; in September watch the Cecropia caterpillar make its silk comforter, put on its rubber coat, and go to bed for the winter, 82; and look under the ground for the beds of certain mummies, 87; in April and May bring out your winter cocoons, 89; the moths of the leaf-miners hatch from May to July, 93; monthly schedule of the Tussock-moth, 114; in April Mother Bumble awakens from her Spring nap, 139; tent caterpillars lay their eggs in June and early July, 160
- Moths, when their ancestors first appeared in the world of life, 102; how to find moth chrysalids, 113, 157; the Tussock-moth, its enemies and the enemies of these enemies, 114; the Gypsy-moths and the imported policemen, 114; how you can help these officers of the law and much oblige Uncle Sam, 115; why country moths change their clothes on going to the city, 158; singing moths and butterflies, 276
- Nature Study, its value and delight, 2
- Orchards, ways of protecting them from insect enemies, 37; orchard enemies in the rubbish heaps, 74
- Peckham, Mr. and Mrs., their comments on the intelligence of wasps, 10; on their sleeping habits, 54
- Propolis, how the bees responded to the advertisement of a new brand, 11; what propolis is and how the bees use it, 168
- Protective mimicry, and other protective devices employed by insects, 26; how the canker-worm pretends to be a twig, 77; the walking-stick, 91; the mourning-cloak butterfly's disguise, 159; protective mimicry by the tree-hoppers, 233
- Scientists, the best of them sometimes make mistakes, so don't be afraid to observe and think for fear of making mistakes, 21
- Seventeen-year locusts. (See Cicada)
- Sleeping habits of insects, 49
- Springtails, how they spring, 165
- Squash-vine borer, its biography told in pictures, 3

- Tree-hoppers, how and why they pretend to be thorns, 233
- Walking-sticks, 91; their ability as actors, 92
- Wasps, their artistic sense of form, 7; Fabre's experiments to determine the question of their intelligence, 10; opposite conclusions of the Peckhams on the same question, 10; how wasps study geography, 17; their curious sleeping habits, 54; how they wash their faces, 57; how they spend the winter, 77; the Waterloo ball in Waspdom, 77; how they do their housekeeping, use of pneumatic cleaners, 166; how they make their paper, 172; how the mud-dauber plasters its walls, 175; the three songs of the mason, 175; the great front-door problem among the wasps, 180; how they can their meat, 237
- Wheeler, Prof., on the insect's lack of a sense of pain, 14
- Winter quarters of the insect peoples, 48, 72; winter balls among the butterflies, 79
- Yellow-jackets, how they spend the winter, 77

